Residential Printreading

Third Edition

an ATP publication

Leonard P. Toenjes

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Residential Printreading

Third Edition

AMERICAN TECHNICAL PUBLISHERS, INC.
HOMEWOOD, ILLINOIS 60430

Leonard P. Toenjes

Residential Printreading, 3rd Edition, contains procedures commonly practiced in industry and the trade. Specific procedures vary with each task and must be performed by a qualified person. For maximum safety, always refer to specific manufacturer recommendations, insurance regulations, specific job site and plant procedures, applicable federal, state, and local regulations, and any authority having jurisdiction. The material contained is intended to be an educational resource for the user. American Technical Publishers, Inc. assumes no responsibility or liability in connection with this material or its use by any individual or organization.

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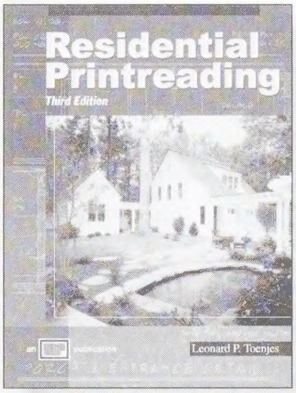
Introduction



Residential Printreading, 3rd Edition, covers common residential construction materials and techniques and relates this information to various residential prints using a fundamental approach. Both printreading and construction practices are presented throughout the book in the sequence that occurs on a job site—from property layout and excavation through finish installation. Review questions are provided at the end of each chapter.

The first five chapters present an introduction to printreading fundamentals. Mathematical skills required when reading prints are integrated throughout the text. Various construction materials and techniques related to a variety of building trades are covered, including carpentry, electrical, plumbing, masonry, and interior and exterior finish work.

Chapters 6 through 11 describe each part of a print beginning with the plot plan and continuing sequentially through the foundation plan, elevations, floor plan, details, and specifications. Materials, abbreviations, and symbols associated with each type of drawing are covered. Abbreviations and symbols reflect common treatment on residential prints. These may vary, depending on the architect's preference.

Chapter 12 provides a comprehensive review of the printreading process. A contemporary one-story house is presented, and each part of the print and its relationship to other print components is described.

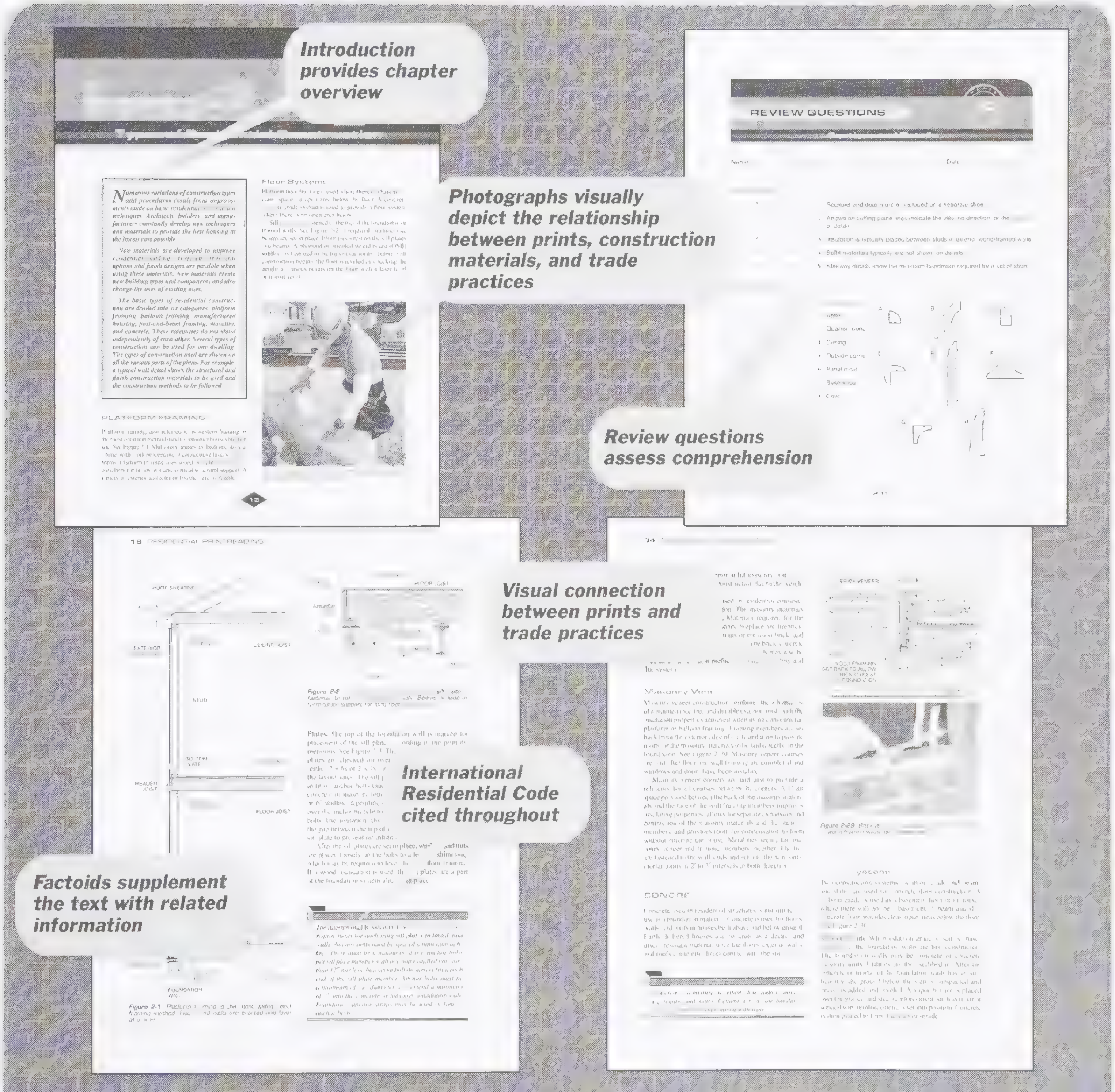
Chapter 13 is comprised of review questions based on prints for a two-story tract house, a one-story ranch house, and a large colonial house. These review questions offer an authentic experience reading various types of residential prints. Questions are grouped to aid in locating the information necessary to answer the questions.

Chapter 14 is the final exam, with questions pertaining to prints from a contemporary multistory house. The final exam is comprehensive and covers construction materials and techniques, abbreviations, symbols, and basic estimating.

Residential Printreading, 3rd Edition, is one of several training products addressing the building trades. To obtain information about related products, visit the American Tech web site at www.go2atp.com.

The Publisher

Features


Introduction provides chapter overview
Photographs visually depict the relationship between prints, construction materials, and trade practices
Review questions assess comprehension
Visual connection between prints and trade practices
International Residential Code cited throughout
Factoids supplement the text with related information
REVIEW QUESTIONS
PLATFORM FRAMING

1 Residential Prints

Residential prints, commonly referred to as blueprints, are comprised of the drawings and written material needed to communicate information to tradesworkers involved in the building process. Prints are used to convey building information from the smallest detail to the largest building dimension. Prints are a means of showing this information in a consistent and reliable form. A set of residential prints shows the location of the building, building size, construction materials, and finishes.

Residential prints serve various functions for the different people involved in the construction process. The architect, builder, and tradesworkers use the prints as a guide to construct a house according to the owner's needs and requirements. A variety of development and design techniques are used to produce a set of residential prints.

PURPOSES OF RESIDENTIAL PRINTS

Residential prints are a common guideline for all people who will design, build, and live in the house to be constructed. See Figure 1-1. A set of residential prints details the building components so that all concerned parties will recognize the shape, systems, and size of the finished building. All information needed to construct the house is provided.

Common Reference

Prints provide a common set of information for all parties involved in the design and construction of the house. Everyone concerned shares a common understanding about the finished building based on the prints. The information is illustrated and written in a consistent manner throughout the plans, sections, details, and specifications of the prints.

Architect. Dimensions, lines, notes, abbreviations, and symbols are included on prints according to standard architectural practices. See Figure 1-2. Architectural styles may vary from architect to architect; however, general standards are typically followed. Standards pertaining to dimensioning, abbreviations, and symbols are developed by technical societies such as ASME International. ASME International copublishes standards with the American National Standards Institute (ANSI). ANSI, along with the American Institute of Architects (AIA), provides structural and design reference materials to architects.

Architects are trained to work with common structural and design reference materials and complete drawings according to standard architectural practices. With this standardization, prints drawn in one locality can be interpreted elsewhere with minimum translation.

Owner. The owner or buyer of a house may not have a complete understanding of printreading. When necessary, architects and builders thoroughly explain all parts of the prints to the owner. Decisions that the owner makes regarding room layout, building location, plumbing fixtures, luminaires (lighting fixtures), and exterior and interior finishes are shown on the prints. The owner approves the building design by signing the general conditions of construction contained in the print specifications. This approval gives the owner's final consent on the print design and specifications to the architect and builder. See Figure 1-3.

Compliance with various building codes is necessary to obtain a building permit.

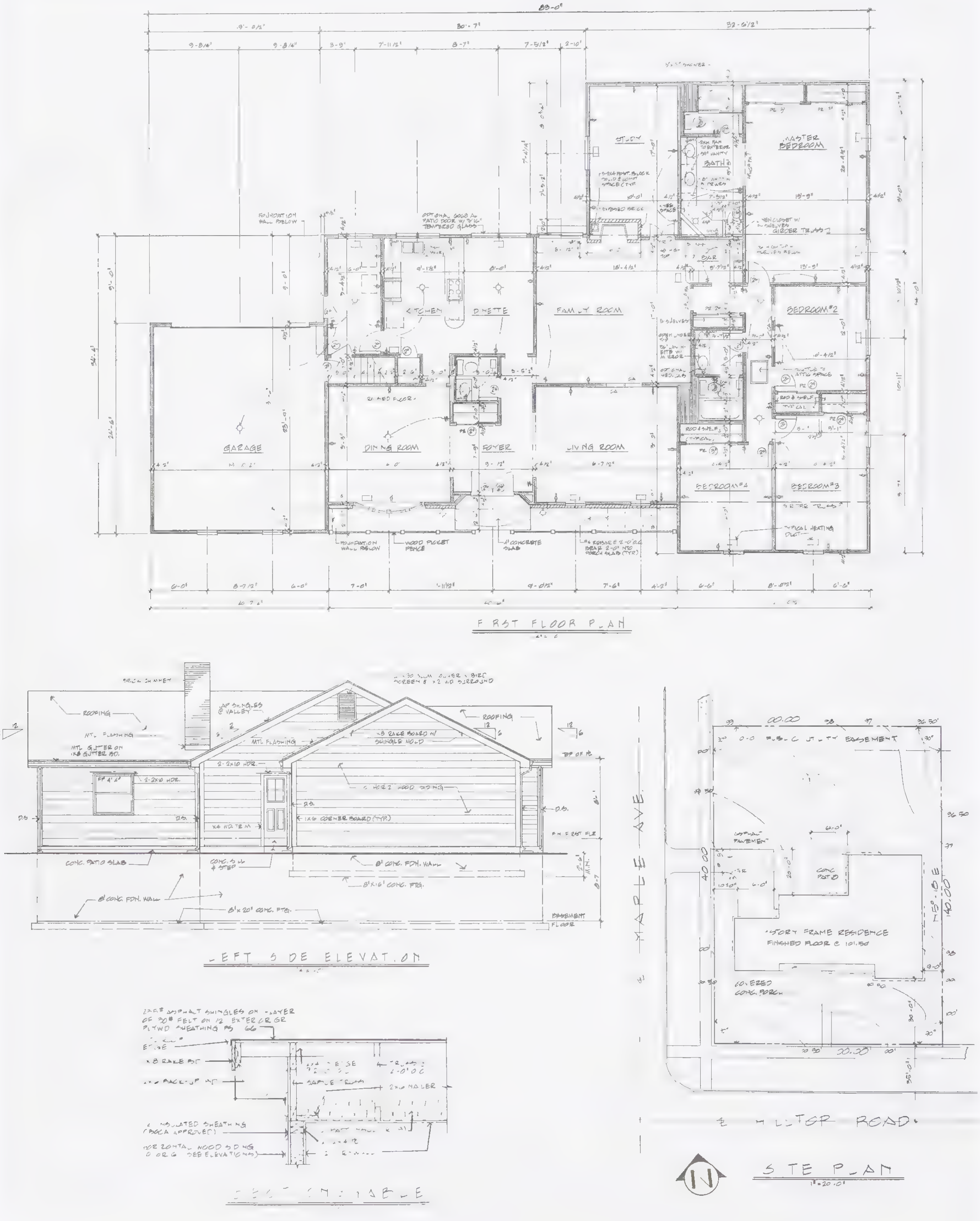


Figure 1-1. Residential prints provide a common source for information required to build a house.

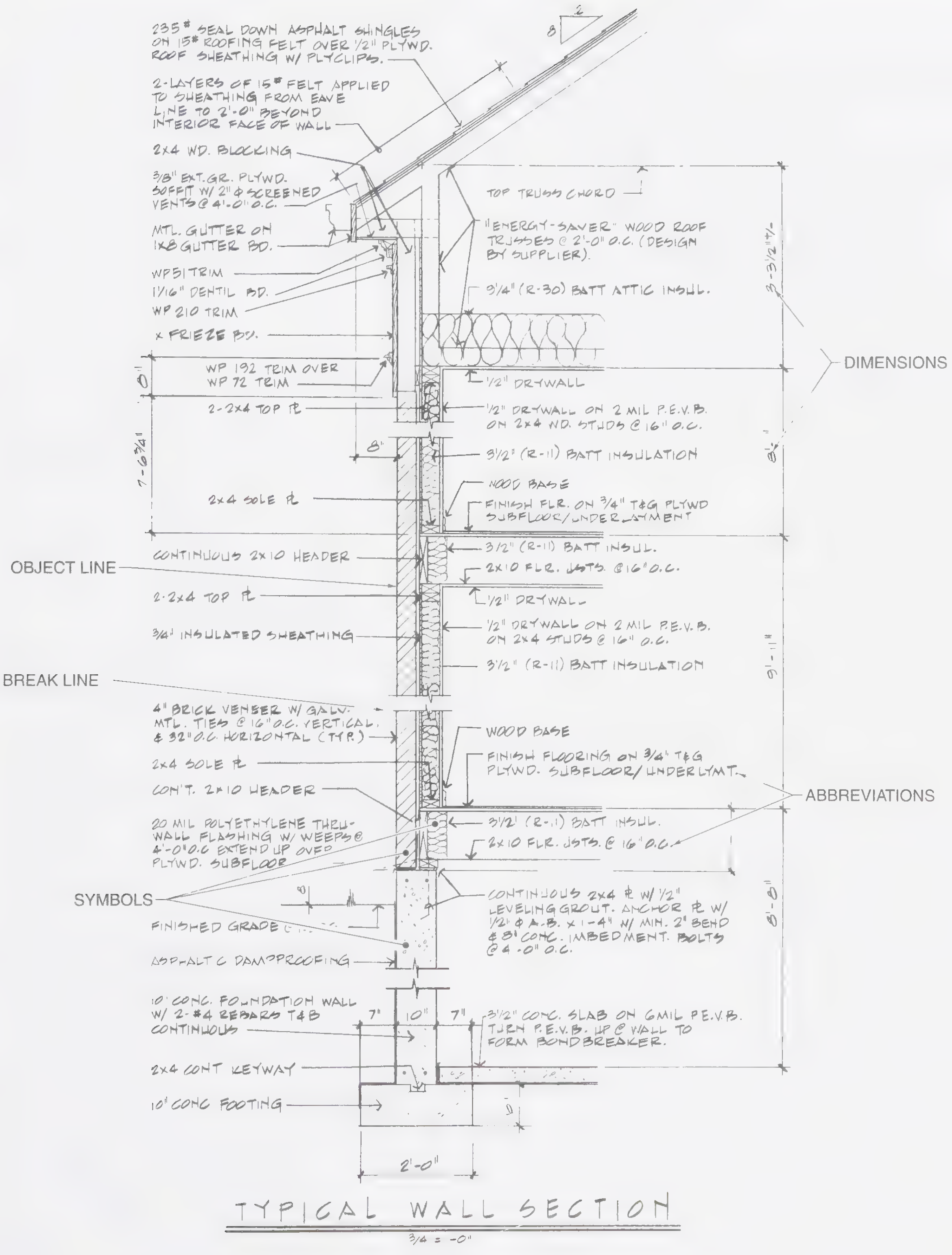


Figure 1-2. Dimensions, lines, abbreviations, and symbols must comply with American National Standards Institute (ANSI) and American Institute of Architects (AIA) standards.

Figure 1-3. A builder and owner agree on the content of the prints before construction begins.

Builder. Based on the prints, the builder develops cost estimates of the amounts of materials and labor needed to construct the house. See Figure 1-4. The builder submits the prints to various subcontractors for competitive bids on a number of services including electrical, plumbing, heating and air conditioning, painting, cabinetmaking, and other construction work that builders do not or cannot perform. The builder and subcontractors agree on the construction materials, installation methods, scheduling, and overall costs of the work according to the dimensions and materials indicated on the prints.

Tradesworkers. Tradesworkers use prints to construct a house that conforms to the design agreement between the architect and owner. Each trade uses the print information that pertains to their required tasks. Prints are drawn to show information and items specific to each of the building operations—for example, framing, masonry, and electrical work.

The building code in effect in a particular jurisdiction must be referred to when constructing a residential structure.

MATERIAL QUANTITIES AND DESCRIPTION Sheet 1 of 3

Project: Johnson's Residence
Location: Lot 82
Subdivision: Willow Trails
Date: 2/17
Estimate No: 533
Estimator: M.E.J.

Description	No. of pieces	Dimensions			Subtotal	Unit Cost	Total Cost	Comments
		Thickness	Width	Length				
1st floor joists	65	2"	10"	16'	—	$18.92	$1229.80	Main house
Rear 1st floor joists	13	2"	10"	12'	—	$11.45	$148.85	Breakfast room
Subfloor	45	3/4"	4'	8'	—	$21.95	$987.75	OSB - T&G
Sills	15	2"	6"	14'	—	$8.24	$123.60	—

Figure 1-4. A builder develops cost estimates to establish labor and material costs.

Building Information

Residential prints provide all the information needed to build a house and designate the building size, shape, and overall appearance. The location of both the building lot and the house on the lot are shown. Dimensions and types of materials to be used in construction are identified and described. Components of electrical and mechanical systems are also shown throughout a set of residential prints.

Location. The location of a house on a building lot is determined by a number of factors, including size and features of the house, the slope of the ground, soil conditions for drainage and support, and building code requirements pertaining to the proximity of the closest building or nearest edge of the building lot. The layout for excavation is based on the building location shown on the print. See Figure 1-5.

Dimensions. An architect provides building dimensions to indicate the sizes for all living areas and information about construction materials to the owner, builder, and tradesworkers. See Figure 1-6. The length of time and amount of materials required to complete construction are based on the length, depth, height, and finish of the house, each room, and each component.

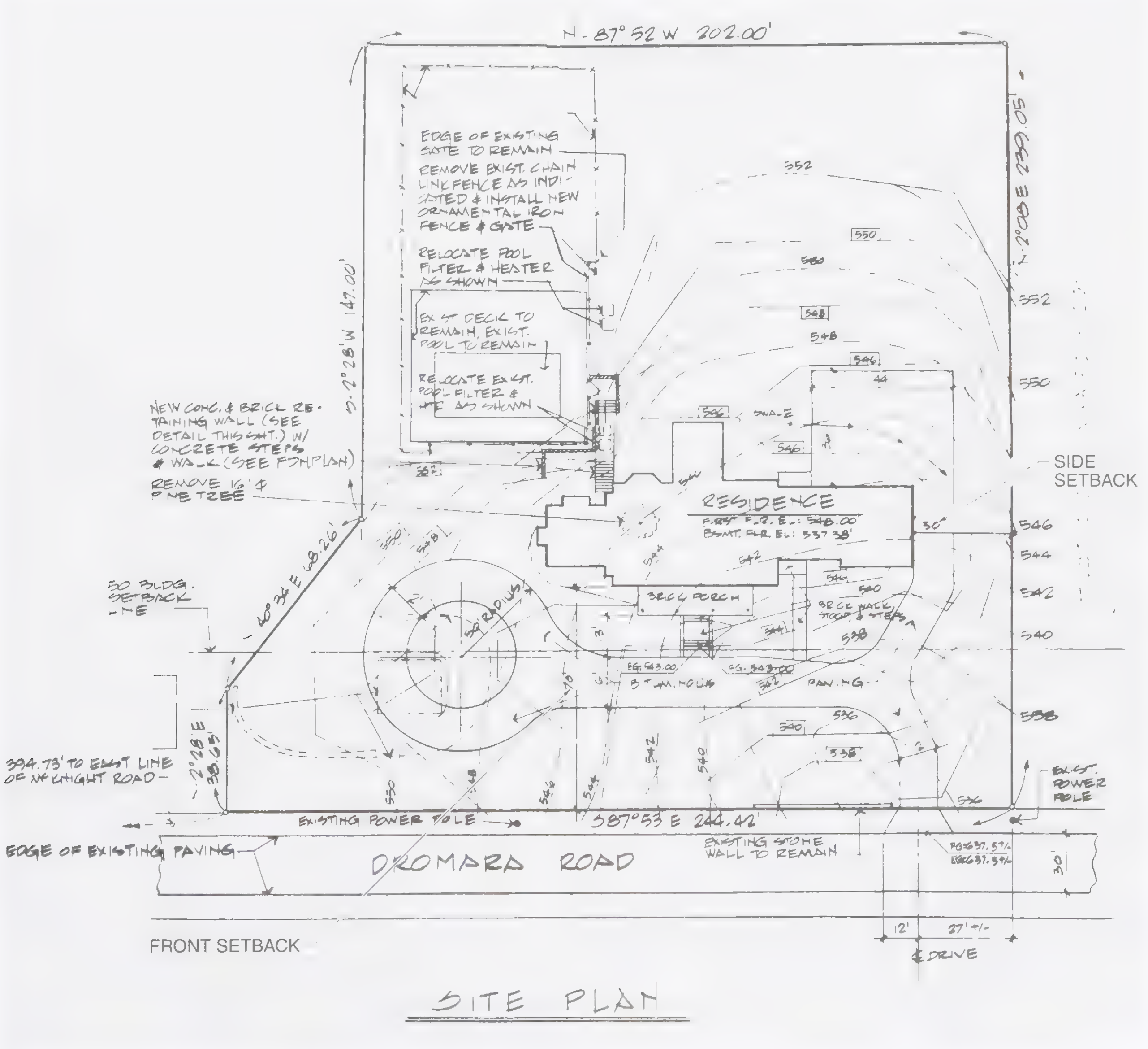


Figure 1-5. Prints show the location of a house on the building lot.

Materials. An architect indicates the types of construction materials and finishes on the print using notations, standard abbreviations, and symbols. The builder, subcontractor, and tradesworkers provide and install the materials according to the print information.

Electrical and Mechanical Systems. For safety and proper operation of the living spaces, residential prints contain symbols and other information indicating electrical and heating and air conditioning systems. Electrical symbols indicate electrical devices, such as luminaires, receptacle outlets, and switches. Mechanical symbols indicate general locations for supply air registers and return air grilles.

Legal Documents

Architectural plans, consisting of prints, specifications, and details, serve as a legal agreement between several parties. The builder must submit plans with an official architectural seal for approval by the local building commissioner before construction of the house can begin. The plans also protect the owner and builder from false claims against each other regarding the construction materials used and construction methods followed.

Plan Approval. After their training is complete, new architects are required to work with a registered architect for a period of time. After this time, new architects take an extensive examination administered by the state in which they plan to practice. Some states have reciprocity agreements for the testing of architects while other states do not. Upon successful completion of the examination, the architects are issued a seal. Architects affix the seal to all plans. See Figure 1-7.

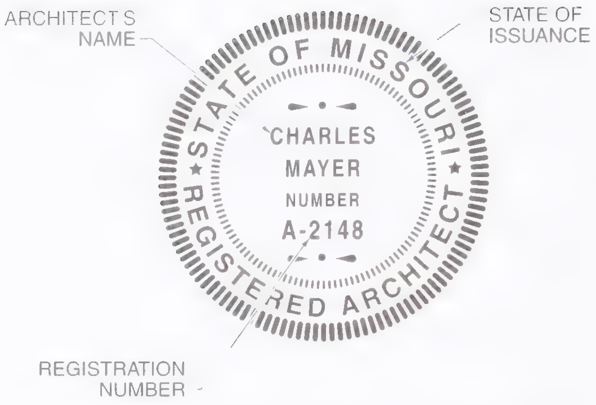


Figure 1-7. An architect's seal certifies that the architect has passed the state examination.

Prints displaying the architect's seal are submitted to the local building commissioner's office for approval. The prints are checked by the building commissioner, who verifies that the local building code requirements have been met. Local building codes are typically based on a model code, such as the *International Residential Code*™. A model code describes the proper building methods and materials for general construction, mechanical, plumbing, and electrical work. The International Residential Code, published by the International Code Council™, was developed by the Building Officials and Code Administrators International, Inc.® (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International, Inc. (SBCCI). The building code with jurisdiction in the particular locality should be referred to when constructing a house.

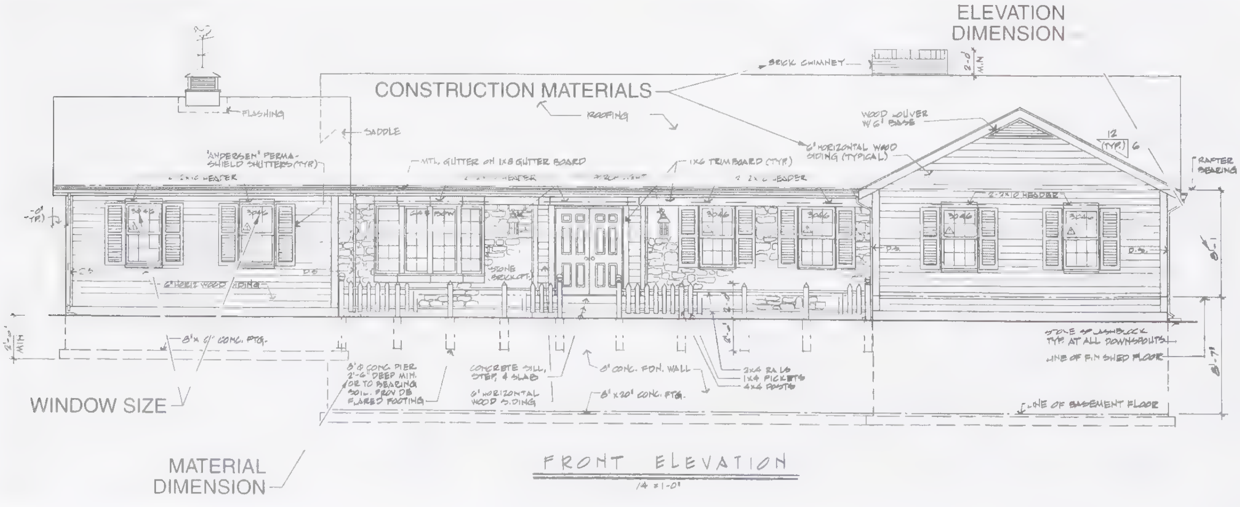


Figure 1-6. Residential prints show dimensions and construction materials to be used.

Building permits must be obtained after the plans are completed and before construction begins. Plans are submitted to local building officials for review and approval. A building permit is issued after the plans are approved by the building commissioner. See Figure 1-8. The building permit must be prominently displayed on the job site. Regular inspections are made to ensure that the house is constructed according to the approved plans. These inspections cover all structural components and the electrical, plumbing, and heating and air conditioning installations. The inspectors note compliance by dating and signing the permit in the appropriate space.

Inspections are conducted before and after the walls are covered with finish materials. Inspections are required before the wall framing is covered with finish materials to provide the inspector access to the rough framing, wiring, plumbing, and other services that are hidden by the finish materials. A final inspection is conducted to check finish fixtures and overall compliance with the building code. The house is ready for occupancy after all inspections are passed.

A building inspector conducts inspection of a house before and after walls are covered with finish materials.

CITY OF KIRKWOOD

AUTHORIZED

Address ______________

Type of Work ______________

Date Permit Issued ______________

Date Permit Expires ______________

Building Commissioner ______________

INSPECTION APPROVALS

1. Sanitary Lateral ______ Date ______
2. Footing ______ Date ______
3. Plumbing Ground Rough ______ Date ______
4. Plumbing Rough ______ Date ______
5. Electrical Rough ______ Date ______
6. Building Framing ______ Date ______
7. Mechanical Systems ______ Date ______
8. Plumbing Final ______ Date ______
9. Electrical Final ______ Date ______
10. Building Final ______ Date ______

Any Questions Regarding Above Call City Hall

City of Kirkwood, MO

Figure 1-8. *A building permit must be displayed on the job site.*

Content Agreement. The entire set of plans is a legal document binding the builder and owner in an agreement about the house to be built. Written specifications are a part of the plans. Specifications provide written information about locations, dimensions, and materials that are not detailed on the prints. The owner and builder sign the specifications, which then serve as an agreement for all information contained on the plans and in the written specifications.

After the agreement is signed, any changes the owner desires, such as a different floor finish material or different types of doors, are submitted to the builder as written work-order changes. The change orders become an addendum to the agreement. See Figure 1-9. Plans provide the owner with a drawn and written document that furnishes all the building information about the house. The builder is legally bound to construct the house as shown on the plans.

A MASON GROUP COMPANY

J.L. Mason of Missouri, Inc.

ADDENDUM TO CONTRACT

15510 Olive Blvd
Chesterfield, MO 63017

FOR OFFICE USE ONLY

Subtotal ______

Final Sales Price ______

Date 12-16- Stage ---

Consultant ------

Purchaser James G. Pierce

Is this a late ATC? Yes ☐ No ☒

Contract Acceptance Date 12-6-

Model Colonial

Lot # 212

Subdivision Oak Trail

Elevation 352.1'

		AMT $
1	Change carpet in living room and dining room to Wellco, Anso IV, Suede Plus IV, 0088	
	Wild Rose. Face weight 36 oz. per square yard. 65 square yards total at $10.50/sq. yd.	$682.50
	Note: Carpet pad as indicated in specifications is to be used.	
	Page Subtotal	$682.50

Any additional Addendums to Contract received later than 15 days from Original Contract date must be paid in cash and will be subject to a $75.00 surcharge per item. Charges hereon shall be in addition to the sales price listed on the "Agreement for Purchase and Sale of Residence", to which this Addendum to Contract is incorporated by reference.

1. Subcontractors will only be paid for extras listed above or field generated extras which are accompanied by a J.L. Mason work order or purchase order signed by superintendent.
2. Each subcontractor should verify color selection upgrades as listed or upgrades above. Report all discrepancies PRIOR to performance.

OWNER APPROVAL J. G. Pierce DATE: 12-16 BUILDER APPROVAL J. L. Mason DATE: 12-16-

White—Office (Legal)
Yellow Copy—Purchasing

Pink Copy—Sales
Gold Copy—Customer

J.L. Mason of MO, Inc

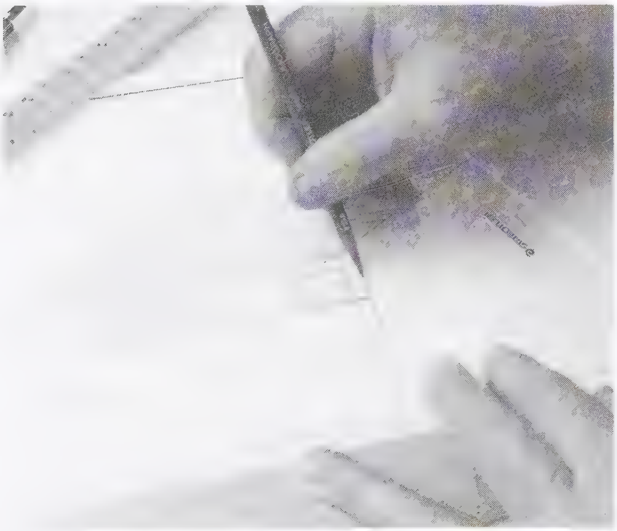
Figure 1-9. Written work orders detail changes that are not shown on the original plans.

RESIDENTIAL PRINT DEVELOPMENT

Residential prints are designed and developed in a number of ways. An architect will design a residential plan for a specific builder, manufacturer, or owner based on certain criteria and requirements. The most common method used to develop plans is computer-aided drafting (CAD) systems, which involve the use of a computer system to generate high-quality drawings quickly and accurately.

Architect Designs for Builder/Manufacturer

Successful builders and manufacturers of residential housing have experience in judging the wants and needs of homebuyers. Builders may employ several architects on their staff or subcontract to an architectural firm to develop house plans targeted to sell in a specific market area. Factors such as overall house and lot size, exterior and interior appearance, general floor plan, and cost are taken into account by the builder. An architect then designs a house that carries out the builder's general ideas and fits into the design and structural requirements of the local building code. For a subdivision development, or for manufactured, prefabricated, and modular homes, several design variations may be provided based on the same general criteria. Variations of exterior and interior finishes are included on the prints to allow the builder or manufacturer to modify each house to suit each buyer. See Figure 1-10.



Manual drafting methods, utilizing T-squares, triangles, and scales, may be used to develop drawings included on a set of residential prints.

A major benefit of a CAD system is its information management capabilities. As drawings are initially generated or changed, information about the materials used in the drawings is stored and updated, allowing the operator to extract the information for estimating purposes.

Architect Designs for Owner

Homeowners may have specific ideas and designs they want to incorporate into their house. The owner, builder, and architect work together closely to design a house that complies with the owner's requirements for floor plan layout and interior and exterior appearance. This method of design is usually available to the owner who can afford to hire an architect to develop custom plans and a custom builder to construct the house.

Print Creation

Standard practices for drawing residential prints have been developed over many years although changes have occurred in the methods used to generate and reproduce architectural drawings. Developments in computer-aided drafting systems allow architects to generate and revise drawings efficiently.

Manual Drafting. When generating architectural drawings using manual drafting methods, architects typically start by roughly sketching design ideas on paper. The rough sketches are refined and developed to determine building location on the lot, room layout, interior and exterior appearance, and electrical and mechanical provisions. Final drawings are then generated. See Figure 1-11.

Final drawings are reproduced using one of several methods that create black or blue line drawings on a white background. The drawings are either passed through ultraviolet light machines with specially coated paper or they are photographed to produce copies.

An electrostatic printer is commonly used to reproduce architectural plans. In the electrostatic printing process, full-size plans are exposed to light and projected directly through a lens onto a negatively charged drum that transfers the image to positively charged copy paper.

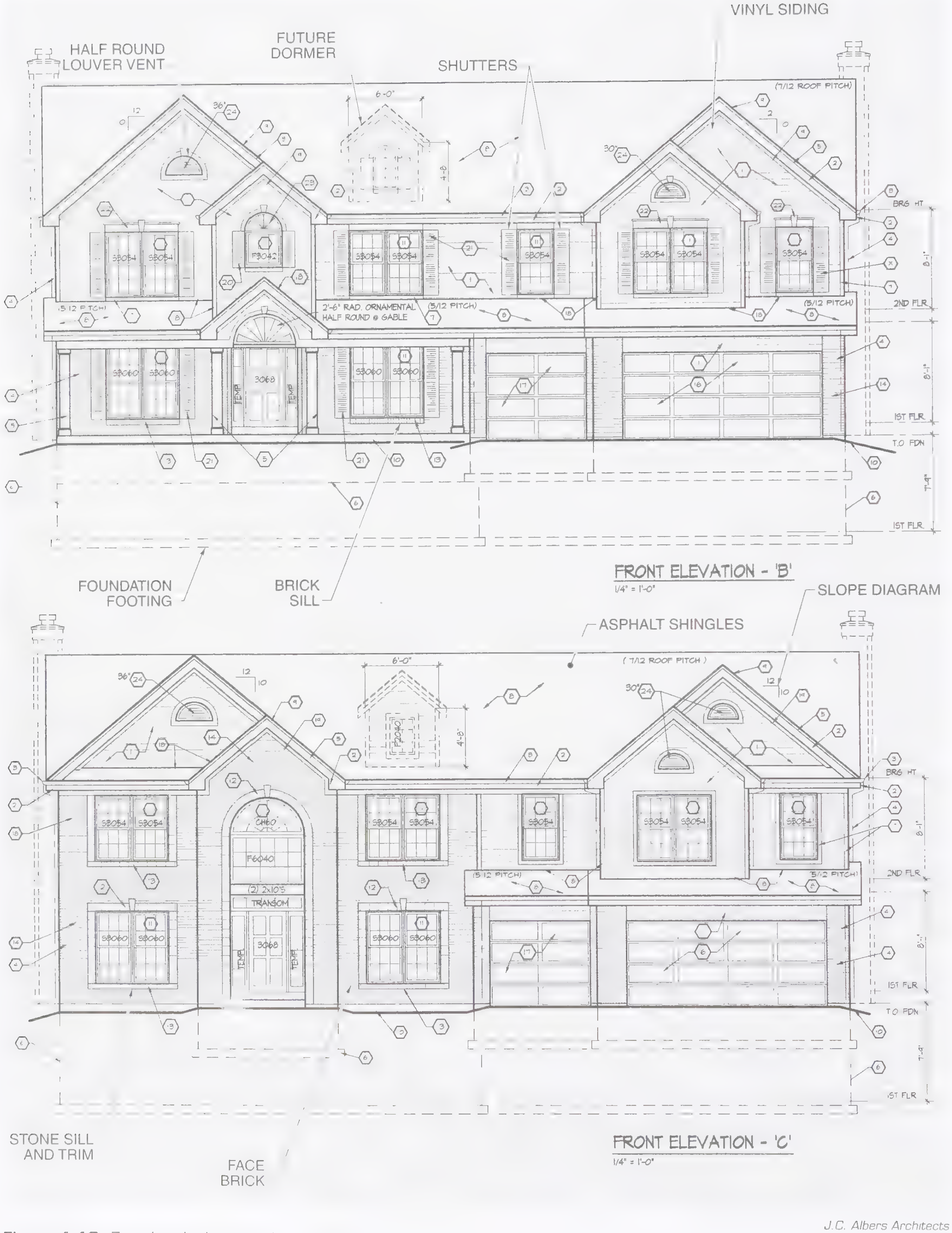


Figure 1-10. Exterior design may be modified for a set of plans.

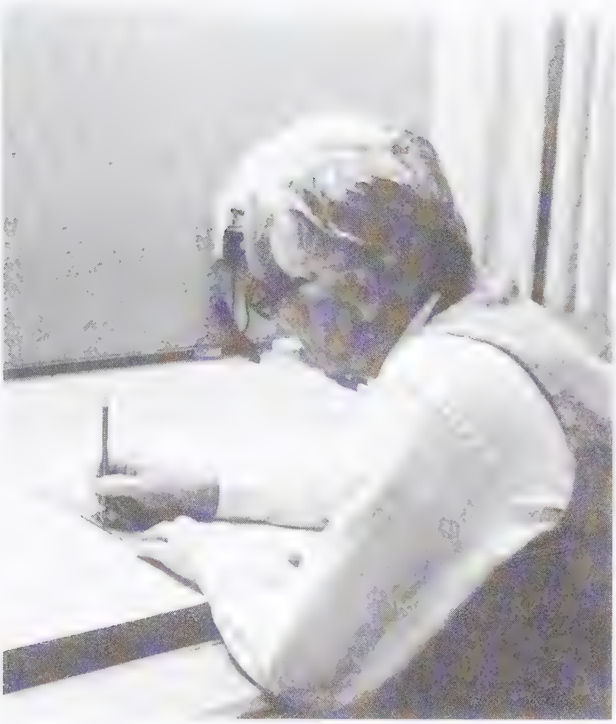


Figure 1-11. Architects produce original drawings for prints.

CAD Systems. Computer-aided drafting (CAD) systems enable architects to make drawings electronically using a computer. CAD systems are comprised of various hardware components and software programs.

CAD system hardware is the equipment that accepts the data entered, performs the data processing, and generates the drawings. The data entry hardware commonly includes a keyboard, monitor, computer, and mouse. A keyboard used to input data into a CAD system is similar to one used for other computer applications. A monitor is used to view the work in progress, such as a drawing as it is developed or revised. See Figure 1-12. Computers used for CAD applications require a large amount of random-access memory (RAM) due to the relatively large sizes of CAD files. A mouse is used to input information by moving it around on a working surface to input the desired function.

When the architectural drawings are complete, the drawings are output to a large-format printer or plotter. A printer or plotter produces lines, letters, and symbols on large sheets of paper or film. The computer-generated drawing is reproduced as prints in the same manner as manual drawings.

Software is the program that allows a computer to process all data entered by an architect. Many types of CAD software are available. Common symbols may be provided as part of the software, which eliminates the need to repeatedly draw common symbols used on drawings. The type of software required depends on the complexity of the application and the type of CAD hardware used.

CAD files are commonly stored in the computer memory to allow for quick retrieval and modification of a specific drawing. The files may be copied to compact discs (CDs) and sent to other users or transmitted to other users via the Internet.

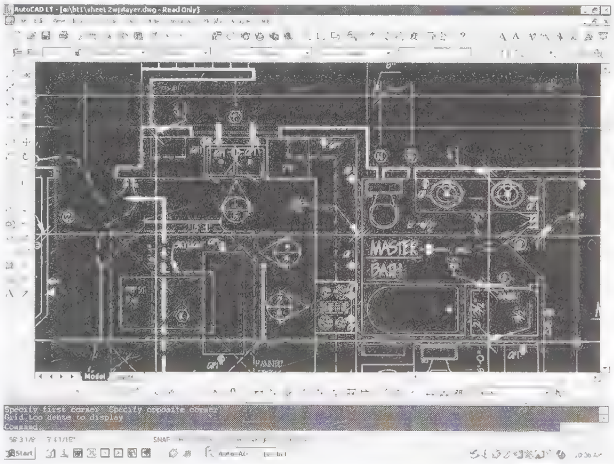


Figure 1-12. Computer-aided drafting (CAD) systems use hardware and software programs to develop drawings electronically.

REVIEW QUESTIONS

1

Residential Prints

Name ______________________________ Date ______________

True-False

T F 1. Symbols and abbreviations used on prints are based on the building code.

T F 2. An owner signs the general conditions of construction before construction begins.

T F 3. Each building trade has a separate print depicting only their work for each part of the house.

T F 4. Most house plans are drawn for a specific owner.

T F 5. The current method used to reproduce prints produces black or blue lines on a white background.

T F 6. Drafting style is consistent from one architect to another.

T F 7. The layout for excavation of a house is based on the building location shown on the prints.

T F 8. Architectural plans contain prints, specifications, and details.

T F 9. CAD drawings are drawn with a T-square, triangles, and other drafting instruments.

T F 10. Abbreviations are not included on residential prints.

Multiple Choice

______________ 1. An estimate includes ___.

A. location of a building on the lot
B. material and labor amounts
C. depth of excavation
D. all of the above

______________ 2. A builder must submit plans with a(n) ___ for approval by the local building commissioner before construction of a house can begin.

A. security deposit
B. official architectural seal
C. scale model
D. none of the above

______ **3.** The location of a house is determined by the ___.
A. ground slope
B. building code requirements
C. soil conditions
D. all of the above

______ **4.** Building materials and finishes are indicated on a print by ___.
A. symbols
B. abbreviations
C. notations
D. all of the above

______ **5.** Inspections on a house are conducted ___.
A. before walls are covered
B. after walls are covered
C. to ensure overall compliance with building codes
D. all of the above

______ **6.** The *International Residential Code* is published by the ___.
A. American Institute of Architects
B. American National Standards Institute
C. International Code Council
D. International Conference of Building Officials

Completion

______ **1.** A(n) ___ is conducted to check overall compliance with the building code before occupancy.

______ **2.** A luminaire is also referred to as a(n) ___.

______ **3.** After passing an examination administered by the state in which an architect plans to practice, the architect is issued a(n) ___, which is affixed to the prints.

______ **4.** ___ provide written information about locations, dimensions, and materials not detailed on the prints.

______ **5.** A(n) ___ to a contract details changes that do not appear on the original plans.

______ **6.** ___ submit bids to the general contractor for work that will not be performed by the general contractor.

______ **7.** A building ___ must be displayed on the job site before construction begins.

CHAPTER 2

Types of Residential Construction

Numerous variations of construction types and procedures result from improvements made on basic residential construction techniques. Architects, builders, and manufacturers constantly develop new techniques and materials to provide the best housing at the lowest cost possible.

New materials are developed to improve residential buildings. Different structural options and finish designs are possible when using these materials. New materials create new building types and components and also change the uses of existing ones.

The basic types of residential construction are divided into six categories: platform framing, balloon framing, manufactured housing, post-and-beam framing, masonry, and concrete. These categories do not stand independently of each other. Several types of construction can be used for one dwelling. The types of construction used are shown on all the various parts of the plans. For example, a typical wall detail shows the structural and finish construction materials to be used and the construction methods to be followed.

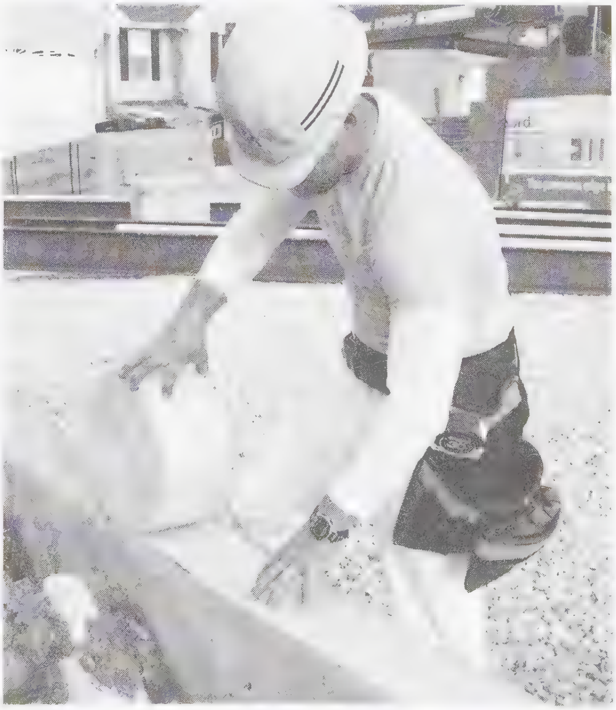
PLATFORM FRAMING

Platform framing, also referred to as western framing, is the most common method used to construct houses built on site. See Figure 2-1. Multistory houses are built one story at a time, with work proceeding in consecutive layers or platforms. Platform framing uses wood or light-gauge metal members for horizontal and vertical structural support. A variety of exterior and interior finishes are available.

Floor Systems

Platform floor framing is used where there is a basement, crawl space, or open area below the floor. A concrete slab-on-grade system is used to provide a floor system where there is no open area below.

Sill plates are fastened to the top of the foundation or framed walls. See Figure 2-2. If required, intermediate beams are set in place. Floor joists rest on the sill plates and beams. A plywood or oriented strand board (OSB) subfloor is fastened to the tops of the joists. Before wall construction begins, the floor is leveled by checking the height at various points on the floor with a laser level or transit-level.



Strips of insulation are placed along the top of the foundation wall before sill plates are installed.

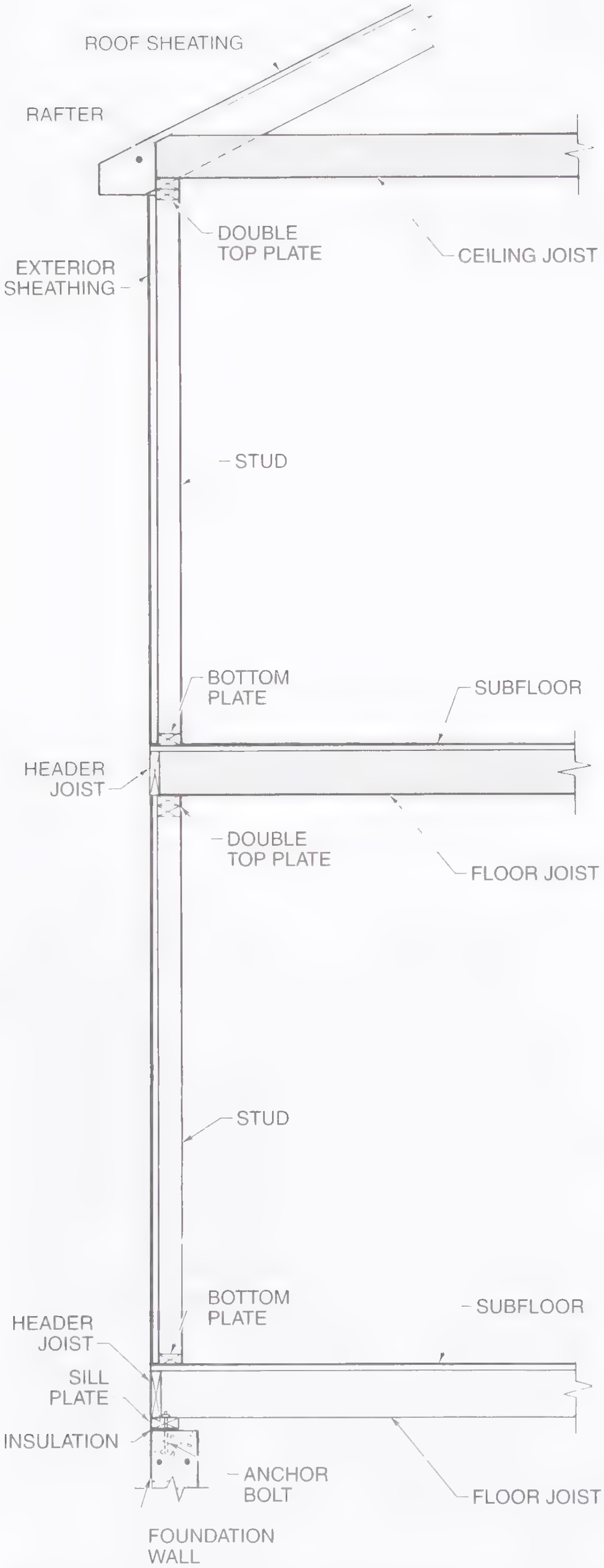


Figure 2-1. *Platform framing is the most widely used framing method. Floors and walls are erected one level at a time.*

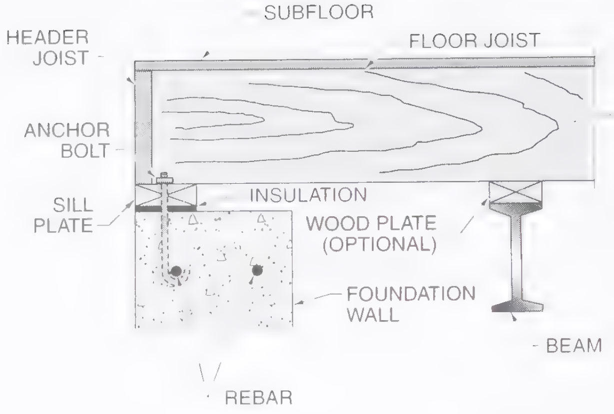


Figure 2-2. *In platform floor framing, the sill plate is fastened to exterior foundation walls. Beams provide intermediate support for long floor-joist spans.*

Plates. The top of the foundation wall is marked for placement of the sill plates according to the print dimensions. See Figure 2-3. The layout marks for the sill plates are checked for overall squareness. Sill plates (either 2 × 6s or 2 × 4s) are cut to length according to the layout lines. The sill plates are marked and drilled to fit on anchor bolts that project out of the top of the concrete or masonry foundation wall. Insulation in 4″ or 6″ widths, depending on sill plate width, is placed over the anchor bolts before the sill plates are set on the bolts. The insulation, also referred to as a sill sealer, fills the gap between the top of the foundation wall and the sill plate to prevent air infiltration.

After the sill plates are set in place, washers and nuts are placed loosely on the bolts to allow for shimming, which may be required to level the final floor framing. If a wood foundation is used, the sill plates are a part of the foundation system already in place.

The International Residential Code *provides minimum requirements for anchoring sill plates to foundation walls. Anchor bolts must be spaced a minimum of 6′ OC. There must be a minimum of two anchor bolts per sill plate member, with one bolt installed not more than 12″ nor less than seven bolt diameters from each end of the sill plate member. Anchor bolts must be a minimum of ½″ diameter and extend a minimum of 7″ into the concrete or masonry foundation wall. Foundation anchor straps may be used in lieu of anchor bolts.*

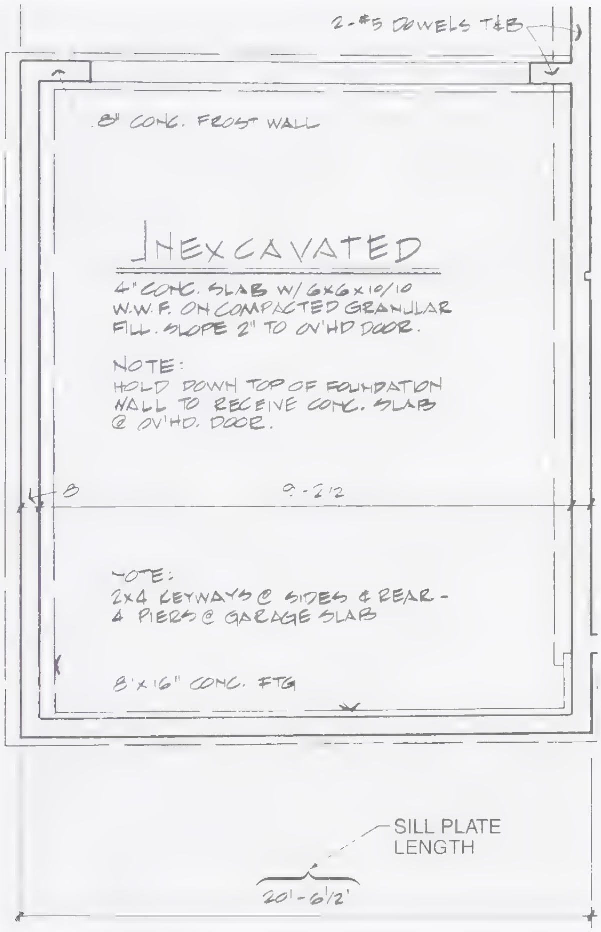


Figure 2-3. Print dimensions indicate the plate lengths to be marked on the foundations.

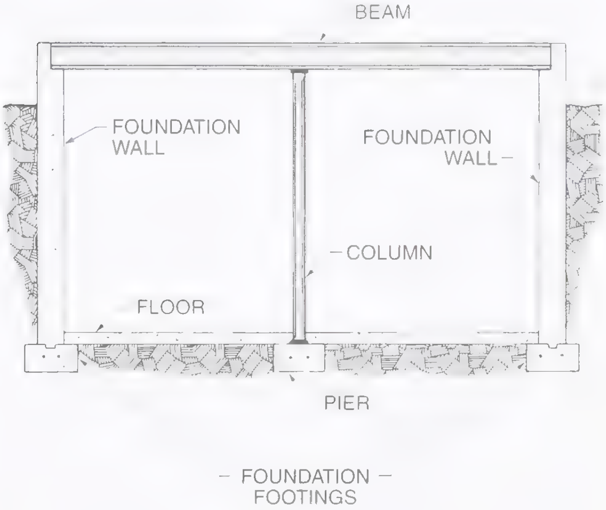


Figure 2-4. Beams and columns provide intermediate support for floor framing.

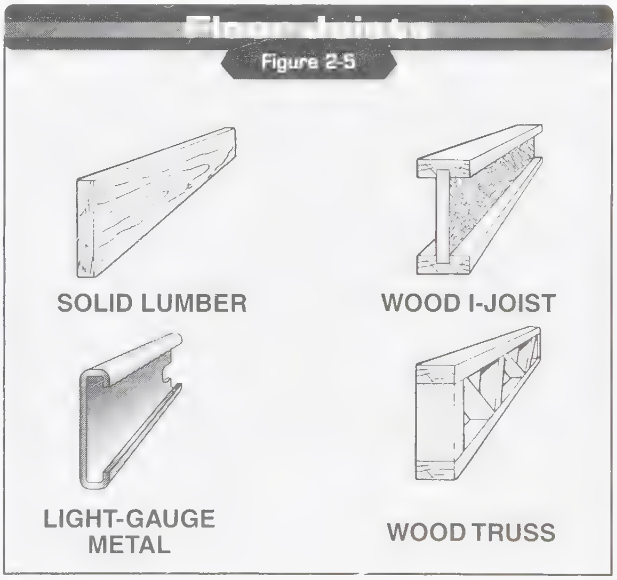


Figure 2-5. Solid lumber joists, wood I-joists, light-gauge metal joists, and wood trusses are used for residential construction.

Beams. A built-up wood, glued laminated (glulam), or steel beam provides intermediate support for floor joists where there is a long span between foundation walls. See Figure 2-4. Intermediate beams are not required for a short span between foundation walls. A recessed pocket formed in the foundation wall supports the ends of the beam. Long beams are supported at various intermediate points by columns. When a steel beam is used, a wood plate can be attached to the top of the steel for fastening framing members.

Floor Joists. Floor joists are solid lumber (typically 2 × 8s, 2 × 10s, or 2 × 12s), wood I-joists, light-gauge metal, or prefabricated wood or metal trusses. See Figure 2-5. Floor joist size and spacing is based on the distance spanned and the load supported. For example, No. 2 southern pine 2 × 10 floor joists spaced 16″ on center (OC) will support 10 psf (pounds per square foot) of dead load plus 40 psf of live load for a span not greater than 16′-1″.

Header joists, also known as band boards, are nailed to the ends of the floor joists, flush with the outside edge of the sill plates. Header joists prevent the floor joists from rolling or tipping, support the wall above, and fill in the spaces between the floor joists. Header joists are of the same size material as the floor joists.

Layout marks for floor joists are made on the header joist. Joists are spaced according to the prints at 16″, 19.2″, or 24″ OC. Joists are doubled or blocking is installed between joists for stairway openings, a load-bearing partition above, or other imposed loads that require additional structural support.

Light-gauge metal joists are similar in size to wood joists and range from 2 × 6s to 2 × 14s.

Headers are installed where joist spans are interrupted by openings such as stairways. Depending on the opening size, the header is either a single or double header with a doubled joist commonly installed on each side. Metal joist hangers provide support at the butt joints between floor joists and header joists. See Figure 2-6.

Where long floor joists are required, bridging is installed to evenly distribute imposed loads. See Figure 2-7. Wood or metal cross bridging or solid bridging is fastened between the floor joists. For cross bridging, only the upper end is fastened during the floor framing process. The bottom is fastened after the house is complete and all loads are in place. Solid bridging may be staggered or installed in a straight line.

Light-gauge metal floor joists are installed in a manner similar to wood floor joists. A rim track is installed at the ends of the floor joists to prevent the joists from twisting. A clip angle fastened to anchor bolts in the foundation wall secures the rim track to the foundation. A bearing stiffener ties the rim track to the floor joists. For long spans, solid blocking or metal strap cross bridging is installed to evenly distribute imposed loads. Self-tapping screws are used to fasten metal framing members together.

Subfloor. The subfloor is fastened to the top of the floor frame to strengthen the floor unit and serve as a base for finish flooring material. Oriented strand board or plywood panels (typically 4′ × 8′ panels) are commonly used for the subfloor. See Figure 2-8. Subfloor panels may have square or tongue-and-groove edges. The tongue-and-groove edges allow the panels to interlock. The panels are installed with the face grain at 90° to the floor joists. The subfloor is glued and fastened to the top of the joists with nails or screws.

Trus Joist, A Weyerhaeuser Business

Figure 2-6. Joist hangers are used to join header joists and floor joists.

APA—The Engineered Wood Association

Figure 2-8. Subfloor panels are fastened to the tops of joists. The panels are installed with the face grain at 90° to the floor joists.

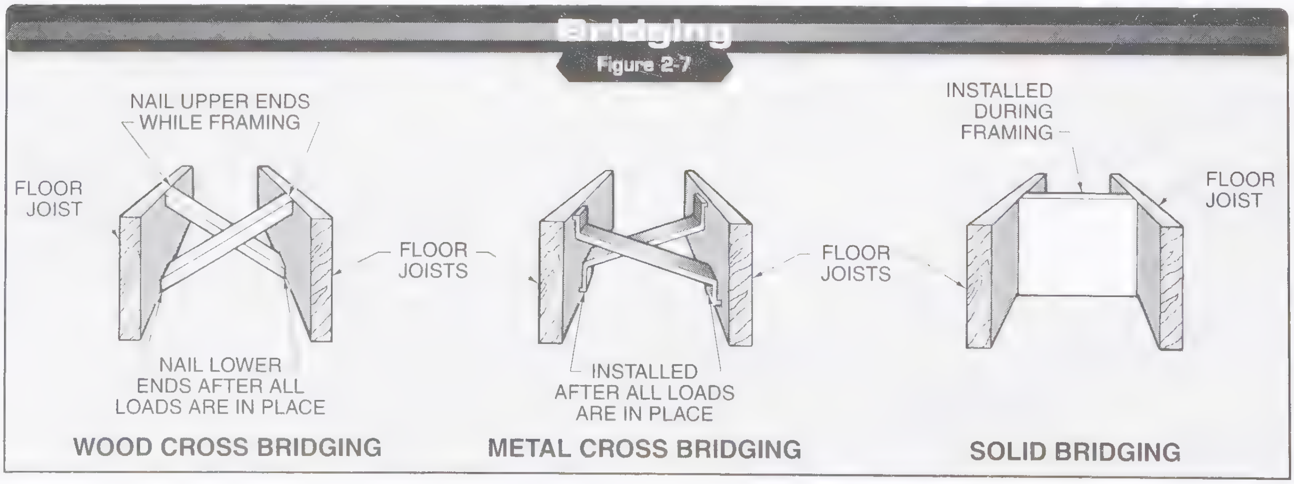


Figure 2-7. Wood or metal bridging evenly distributes imposed loads across floor framing members.

Bows or twists in the joists are straightened during subfloor installation. Each successive row of subfloor is laid out to show proper joist locations. Some panel manufacturers mark 16″, 19.2″, and 24″ lines on the panels to facilitate proper alignment of the floor joists. Joists are moved to the marks and fastened in place.

After the subfloor is installed, the height of the floor is checked. A laser level or transit-level is used to take readings at key points on the floor to determine where shims may be needed to raise the floor to level it. Underlayment and finish flooring are installed after the exterior and interior walls and partitions and roof are completed. See Figure 2-9.

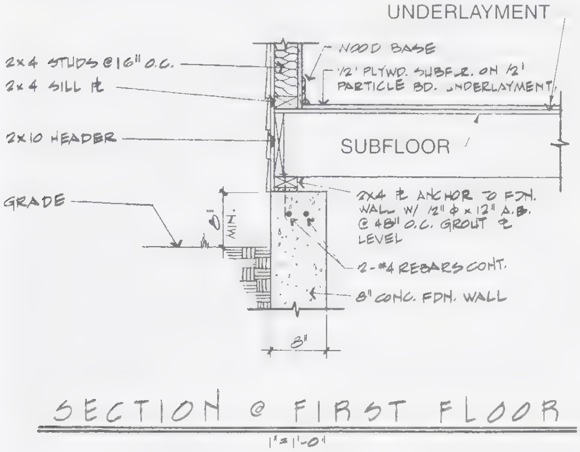


Figure 2-9. Underlayment is attached to the top of a subfloor to create a smooth surface for finish flooring materials

Wall Systems

Platform wood-framed walls are constructed using nominal 2″ (1½″ actual thickness) lumber for vertical structural support, and exterior sheathing or diagonal bracing for horizontal structural support. Horizontal wood members (plates) secure the vertical studs in position. See Figure 2-10. Additional vertical supports for roof and multifloor loads are provided at window and door openings.

Platform metal-framed walls are constructed in a similar construction sequence as wood-framed walls, but with different fastening and bracing materials. Metal studs (C-shapes) are manufactured with similar dimensions as wood framing members. For example, a nominal wood 2 × 4 (actual size 1½″ × 3½″) and a 1½″ × 3½″ metal stud have the same overall dimensions to allow items such as door and window jambs to be installed interchangeably.

Exterior and interior wall finish materials are fastened to the plates and studs. Interior and exterior walls are framed in a similar manner. Load-bearing walls and partitions must be designed to withstand vertical stress (weight load) and horizontal stress (shear load).

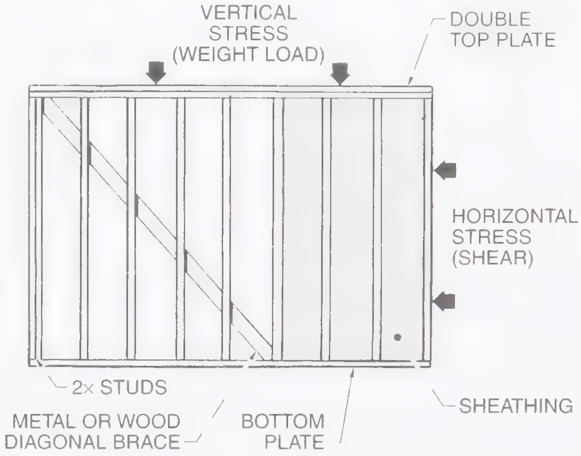


Figure 2-10. Walls are designed to withstand forces and weight from all directions.

Plates. Wall plates are typically 2 × 4s or 2 × 6s, which are cut to the proper length. Plates are marked to indicate stud locations (either 16″ or 24″ OC), frames for window and door openings, and any special framing required to receive intersecting walls.

The lower plate in a platform-framed wall is the bottom plate, which is also referred to as the sole plate. A single bottom plate and double top plate are commonly used for exterior walls and interior load-bearing walls. A double top plate provides additional strength for proper load distribution. See Figure 2-11. A single bottom and top plate are commonly used for non-load-bearing partitions.

Studs. The same size framing members, such as 2 × 4s or 2 × 6s, are used for the studs as are used for the top and bottom plates. Studs are fastened to the plates at the layout marks. Studs and plates are fastened together on the completed subfloor and then raised into position.

Stud length combined with plate thickness determines the ceiling height. See Figure 2-12. Precut studs of different lengths are used to provide a consistent finished ceiling height with the two or three plate thicknesses deducted from the stud length. Longer or shorter studs are used as required to provide different ceiling heights.

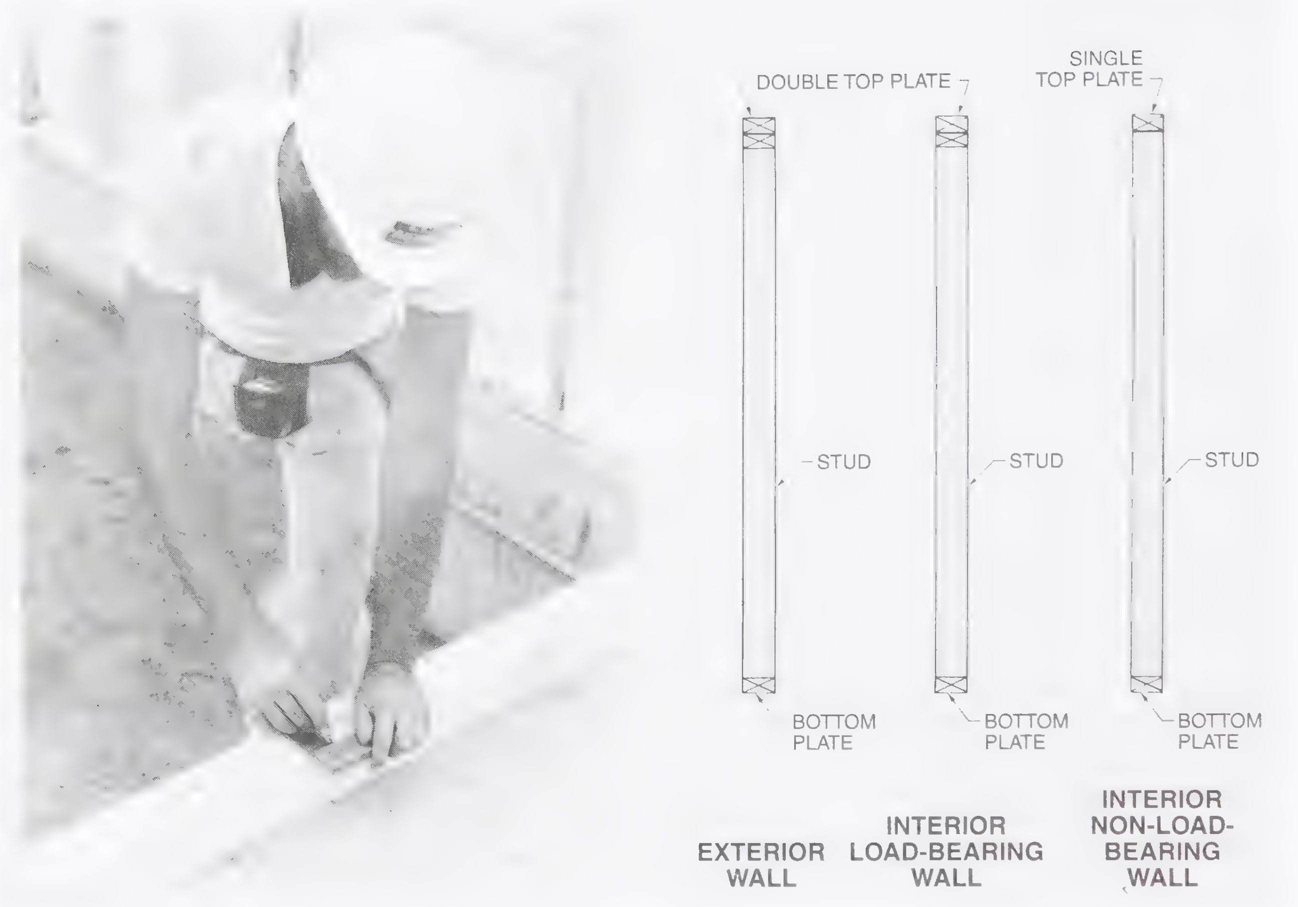


Figure 2-11. Wall designs vary depending on location and support.

Fire blocks are installed in walls as required by the local building code. Fire blocks prevent fire from spreading inside walls by impeding the airflow in the open channels between the studs. Fire blocks are also commonly required where ceilings are furred-down for cabinets or mechanical chases, which create paths for air currents that may spread fire.

Framed Openings. Headers are set on edge over window and door openings. The total width of a header is the same as the actual thickness of the wall studs. For 2 × 4 stud walls, a 4 × 10 or 4 × 12 is cut to length for use as a solid wood header. Two 2 × 10s or 2 × 12s may also be fastened together face to face to construct a built-up header for a 2 × 4 stud wall. Spacers or fillers may be set between the 2 × 10s or 2 × 12s to make the header thickness equal to the stud thickness. For 2 × 6 stud walls, solid wood members may be used as headers, or the headers may be constructed with two 2 × 10s or 2 × 12s over a 2 × 6 base. See Figure 2-13. For openings in non-load-bearing partitions, such as interior doors, single-member headers are constructed with a 2 × 4 or 2 × 6 placed flat across the opening.

Headers are supported on each side of the opening by a full-length stud and a trimmer stud, also referred to as a jack stud. A trimmer stud is a shortened stud whose length is the distance from the bottom plate to the bottom of the header. For a window opening, a rough sill is fastened between the two trimmer studs. The rough sill may also run the full length from stud to stud. In this case, the trimmer studs are cut above and below the rough sill. Cripple studs are installed between the rough sill and bottom plate. If the top of the header does not extend to the top plate, cripple studs are also required above the header.

Glulam members may be used as window and door headers in residential construction.

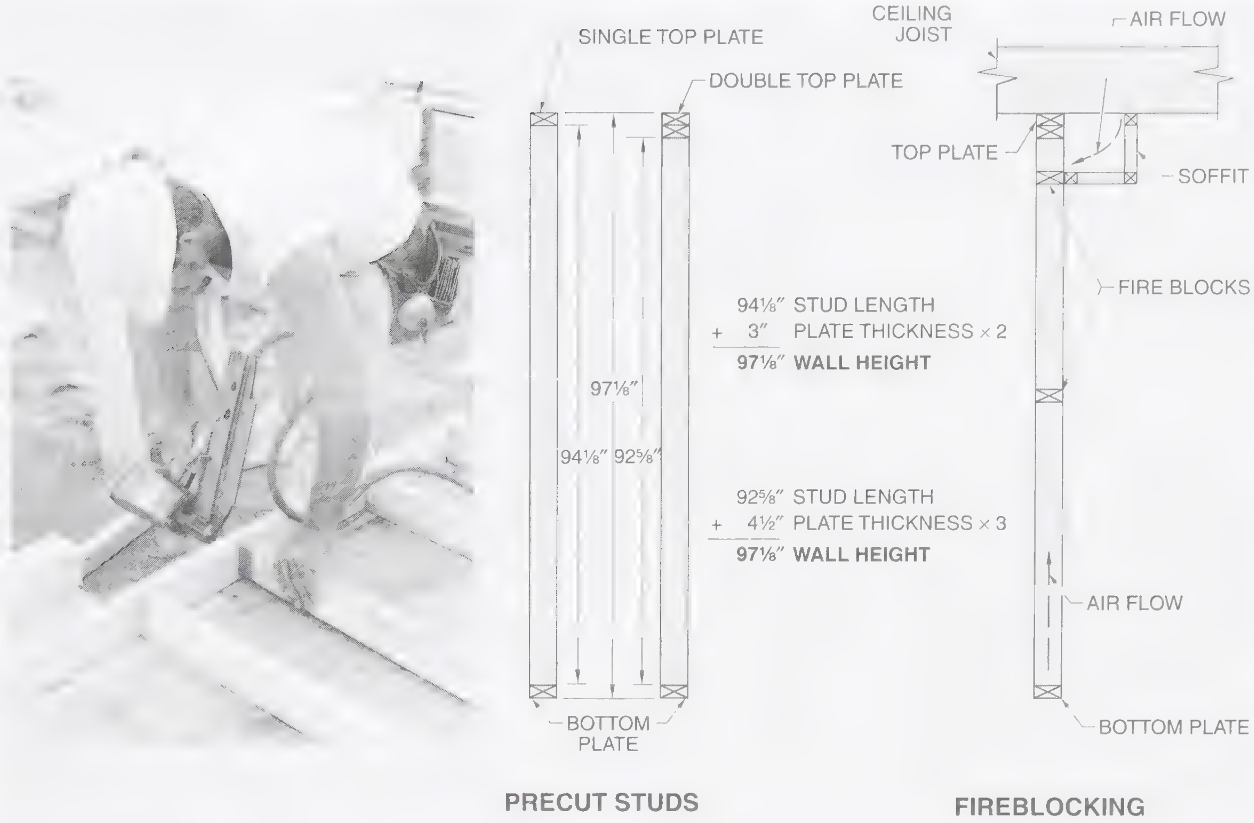


Figure 2-12. *Stud length varies with the number of top plates used. Fire blocks inhibit airflow within framed walls.*

Framing Terminology

Figure 2-13

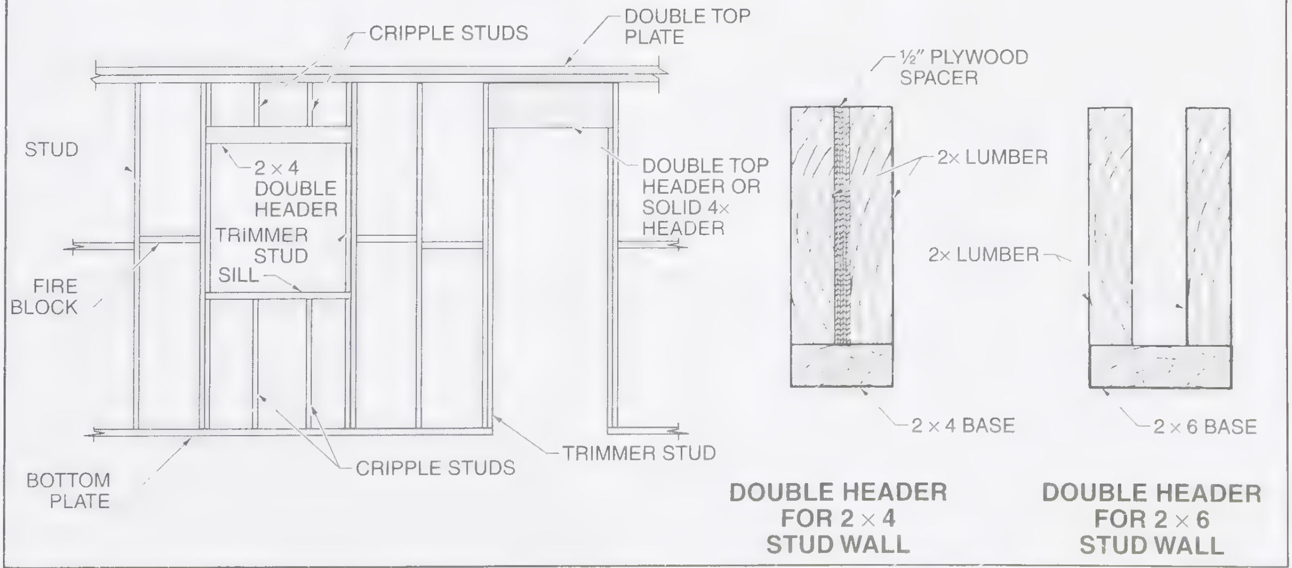


Figure 2-13. *Framed walls consist of several framing members, which strengthen the wall design.*

Exterior Sheathing/Finish. Exterior sheathing is applied to the outside of the wall framing. Exterior sheathing may be oriented strand board, plywood, exterior gypsum board, or expanded foam. See Figure 2-14. Sheathing is applied after the walls are squared on the subfloor and before they are raised into position. Plastic sheets may be fastened to the bottom of first-floor walls before sheathing is installed to act as a moisture barrier where a brick-veneer exterior finish is specified. Exterior finish materials are applied after doors and windows are in place.

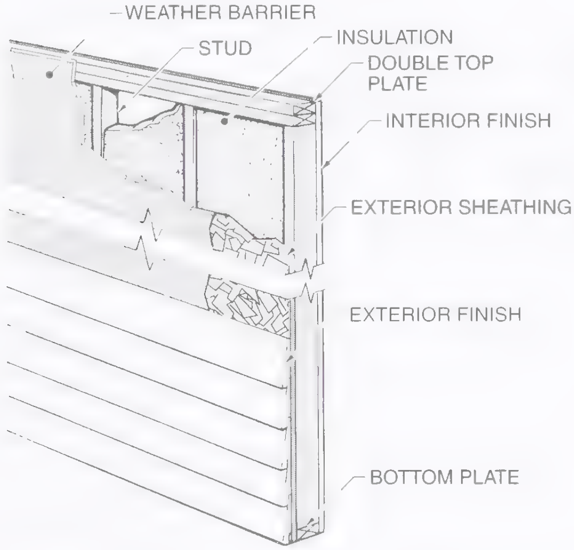


Figure 2-14. Exterior sheathing and a weather barrier are installed over the exterior face of framed walls.

Some types of sheathing, such as plywood and oriented strand board, provide horizontal shear strength for walls. Expanded foam, with or without a foil facing, possesses insulating properties. If expanded foam or exterior gypsum board is used as sheathing, additional bracing is required since these materials provide little shear strength. Diagonal braces, such as metal braces, light-gauge metal straps, or wood 1 × 4 let-in braces, are installed on the outside of framing members to provide lateral strength. A kerf must be cut along the outside edge of framing members to accept metal braces. Framing members are notched along the edge to receive wood let-in braces. Diagonal braces are fastened to the studs and plates before sheathing is installed.

A weather barrier, such as housewrap or building paper, is applied to the wall sheathing after the walls are raised. Housewrap is a translucent spun-plastic sheet material that is tightly wrapped around a building to prevent water and air from penetrating into the house. Housewrap allows the house to "breathe" by allowing moisture vapor and gases from the building interior to move outward without trapping moisture in the wall. A weather barrier is attached to the exterior sheathing using staples or large-head fasteners.

Exterior finish materials are fastened to the exterior sheathing to provide additional protection against water and air penetration. Exterior finish materials include vinyl, metal, fiber cement, wood siding, masonry, and exterior insulation and finish systems (EIFS). Exterior finish materials are applied after the window and door frames are set in place. Masonry finishes are laid on the foundation and attached to wall framing members with metal anchors.

Where EIFS is installed, foam insulation panels are fastened to the exterior sheathing using an approved adhesive and/or mechanical fasteners. A base and finish coat of acrylic resin and reinforcing mesh are applied over the foam insulation panels, providing a waterproof, colorfast, crack-resistant finish. All exterior finishes must properly protect around openings and intersections to prevent moisture and air penetration into the house.

Interior Finish. Common interior finish materials include gypsum board (also known as drywall or wallboard), wood paneling, plastic laminate, plaster, and masonry. Interior finish materials are applied after the fire blocks, insulation, and electrical and mechanical services are installed in the framed walls.

BALLOON FRAMING

Balloon framing was first used to minimize the effects of lumber shrinkage. Balloon framing uses basically the same members as platform framing; however, studs for multistory balloon-framed load-bearing walls extend the full length from the foundation to the roof. See Figure 2-15. While balloon framing is not as prevalent today as in the past, it is still used for open framing in multistory residential construction.

Balloon framing has re-emerged in residential construction with the advent of engineered wood products such as laminated veneer lumber (LVL) and parallel strand lumber (PSL). LVL is composed of layered wood veneers and waterproof adhesive. PSL is manufactured from strands or elongated wood flakes that are blended with waterproof adhesive and cured under pressure.

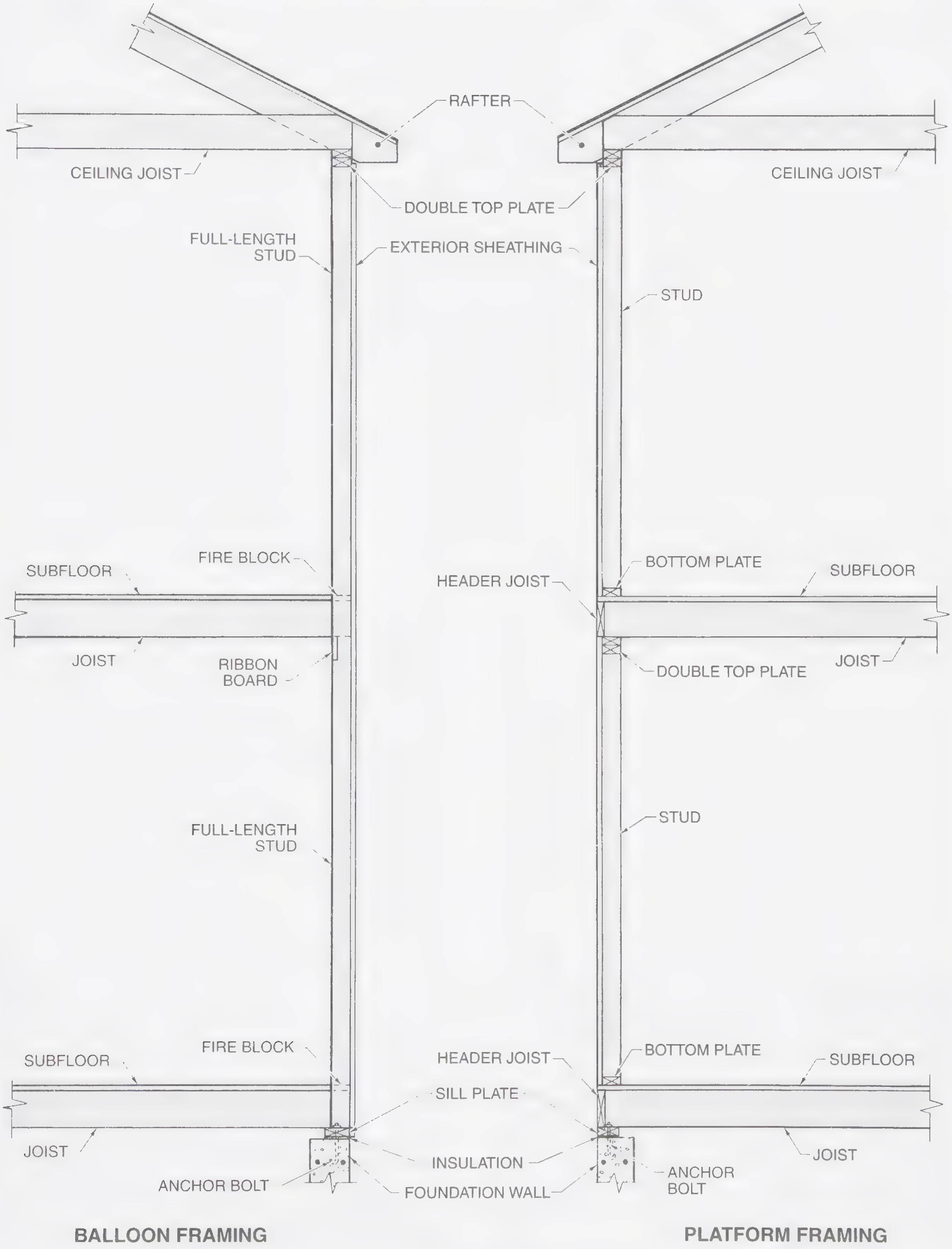


Figure 2-15. *Full-length studs in balloon framing minimize the effects of lumber shrinkage in multistory framing.*

Floor Systems

First floor components for balloon framing are the same as components for platform framing. Plates, beams, and joists are installed in the same manner. Studs bear directly on the sill plates. Blocking is placed between the joists or a header joist is set inside the wall studs to prevent the joists from tipping or twisting. The subfloor is held back from the outside edge of the floor framing. Blocking is installed or the subfloor is notched around the exterior wall studs to close air passages.

With floor systems, the difference between balloon and platform framing is the system used to support upper floors in multistory construction. Floor joists are set on 1 × 4 or 1 × 6 ribbon boards that are notched into the inside face of the full-length studs to provide additional vertical support for the floor structure. Joists are nailed to the side of the studs and bear on the ribbon boards.

Wall Systems

Wall construction is the major distinguishing factor between balloon framing and other framing systems. Plates are laid out for stud placement, corner framing, and opening framing according to the prints. Studs are commonly 2 × 6s or 2 × 4s that extend the full height of the required wall framing. Fire blocks are installed at each floor level to inhibit airflow.

Plates. Top plates and sill plates are laid out for window and door openings and intersecting corners for exterior and interior walls. Depending on stud size and material, studs are placed 16″ or 24″ OC. A double top plate is used. The plates are the same width as the wall studs.

Studs. Long studs are fastened to the top plates. Notches are cut into the studs for the ribbon boards that support the upper floor joists. The bottom of each stud is fastened to the sill plate and the side of a floor joist if possible.

Steel plates may be fastened to top or bottom plates and studs to protect plumbing pipes from puncture.

Framed Openings. Studs, headers, trimmer studs, rough sills, and cripple studs are framed in the same manner as in platform framing. Cripple studs of sufficient length to reach the top plate of the second floor are needed above first floor headers if there is no opening directly above the headers.

Exterior Sheathing/Finish. Exterior sheathing and finish materials are the same as in platform framing. With the effects of lumber shrinkage reduced, balloon framing minimizes cracking where this could be a problem with exterior finish materials.

Interior Finish. Similar materials and methods are used for interior finish as for platform-framed walls. Again, cracks are less likely to occur on the interior finish materials of balloon-framed walls.

ROOF SYSTEMS

The six basic roof designs are flat, shed, gable, hip, mansard, and gambrel. See Figure 2-16. Roofs are either constructed on the job or built with prefabricated components. The methods and designs of roof construction are the same, regardless of the floor and wall framing system on which they are built.

Roof pitch (slope) refers to the angle of a roof. Roof pitch is shown on prints using a slope diagram (small triangle). See Figure 2-17. Two numbers—unit rise and unit run—are included with the slope diagram. The unit rise is the number of inches that a rafter rises vertically for every foot of unit run. The unit run is the horizontal measurement along the slope diagram and is always 12″. For example, a roof that rises 6″ vertically for each 12″ of horizontal length has a 6″ on 12″ pitch.

A fractional roof pitch may also be used on prints to indicate roof slope. The fractional roof pitch is calculated by dividing the total rise by the total span. The total span of a roof is the overall horizontal distance between outside faces of exterior walls. For an equal-pitched roof, the run is always one-half the span. For example, a roof with a total rise of 15′ and total span of 36′ has a $\frac{5}{12}$ fractional roof pitch.

A firestop is a material that seals holes drilled through walls or structural members to inhibit the spread of fire, smoke, and fumes. Firestopping caulk is commonly used as a firestop in residential construction.

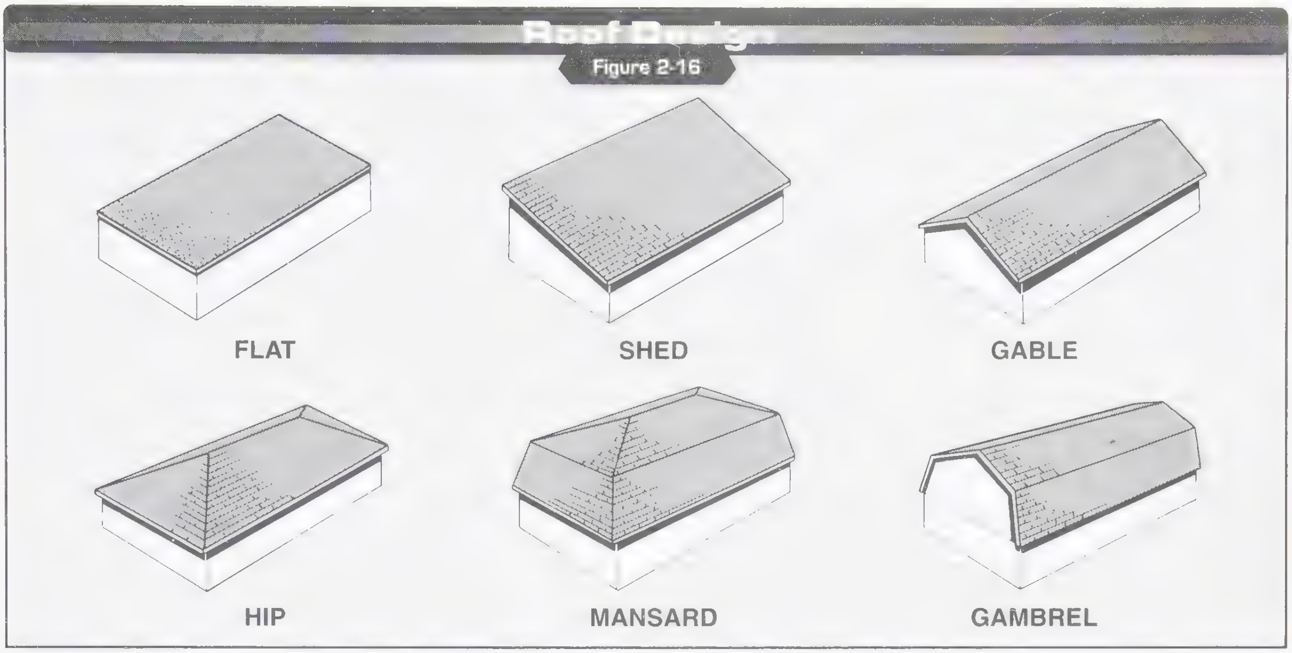


Figure 2-16. Six basic roof designs are used in residential construction.

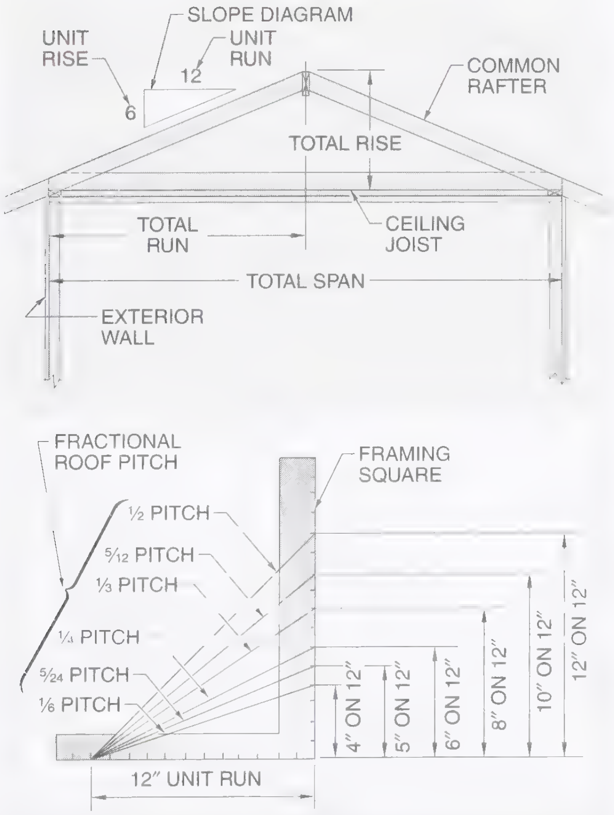


Figure 2-17. Common roof pitches range from 4″ on 12″ to 12″ on 12″.

Roof Types

A flat roof is the simplest type of roof. Rafters with a slight slope are also used as the ceiling joists. A slight slope is required for a flat roof to provide proper drainage and to prevent water or other moisture from accumulating on top of the roof. The minimum slope for a flat roof is ⅛″ of unit rise for each 12″ of unit run.

A shed roof slopes in only one direction. The opposing walls are built to different heights to match the pitch of the roof.

A gable roof slopes in two directions. See Figure 2-18. A ridge board is placed at the peak of the roof to provide a nailing surface for the upper ends of the common rafters. Rafters extend from the top plate of the wall to the ridge board. Gable end walls are framed in a manner similar to walls for a shed roof, with the gable studs varying in length to match the roof pitch.

A hip roof has four sloping sides. All the exterior walls in a building with a hip roof are the same height. See Figure 2-19. Hip rafters extend from outside house corners to the ridge board. Hip jack rafters extend between the hip rafters and the tops of the exterior walls. Common rafters extend from the top plate on all sides of the house to the ridge board.

Mansard roofs are used for multistory houses. The outsides of the upper portion of the walls are covered with sloping surfaces that become the bottom sections of the roof. The roof above the top floor is framed in the same manner as a hip roof.

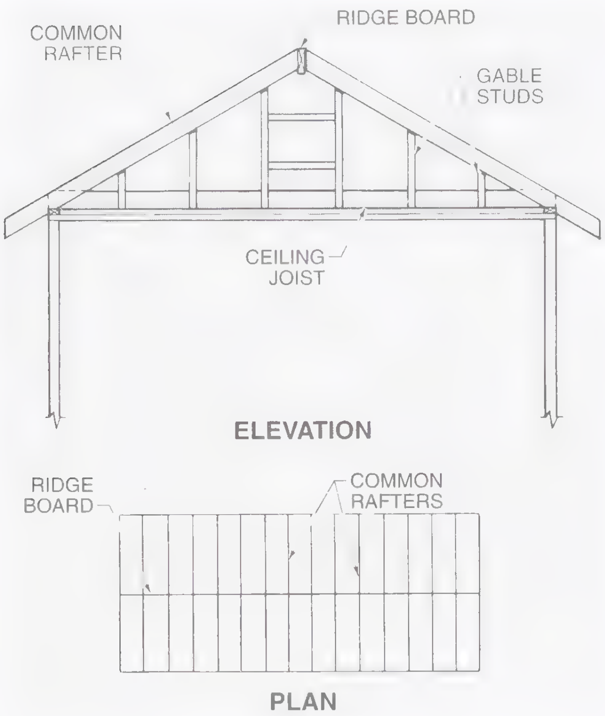


Figure 2-18. Gable roofs have a continuous ridge board and common rafters of the same length.

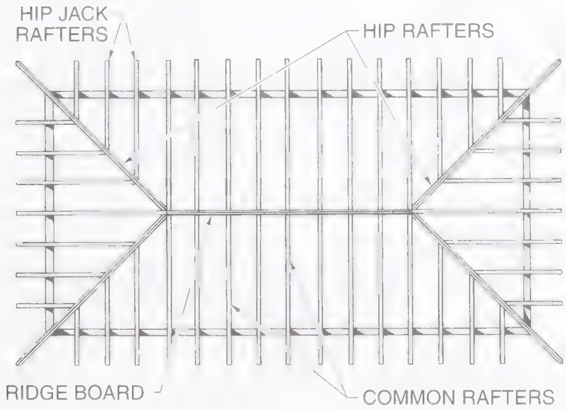


Figure 2-19. Different types of rafters of various lengths are required to construct a hip roof.

A barn roof is an example of a gambrel roof. A gambrel roof is essentially a gable roof with two different slopes on each side to provide the maximum amount of interior space.

Conventional Roof Framing. When a roof is to be framed conventionally, roof components are cut on the job site. The lengths of the ridge, common, hip, and hip jack rafters are determined using tables provided on a framing square, various printed tables, calculators, or on-site measurements.

Based on the prints, ceiling joists are set in place 16″ or 24″ OC on top of the exterior walls and the interior load-bearing walls. While 16″ and 24″ OC are common spacing of ceiling joists, they may also be spaced 12″ or 19.2″ OC. Ceiling joists are typically 2 × 6s or 2 × 8s that are set on edge. The ceiling joists are fastened to the walls to form the interior ceiling and are the structural members that tie the tops of the walls together. When ceiling joists must span long distances, stiffeners made of a horizontal 2 × 4 and a vertical 2 × 6 are fastened to the tops of the joists to strengthen them and prevent them from twisting. See Figure 2-20.

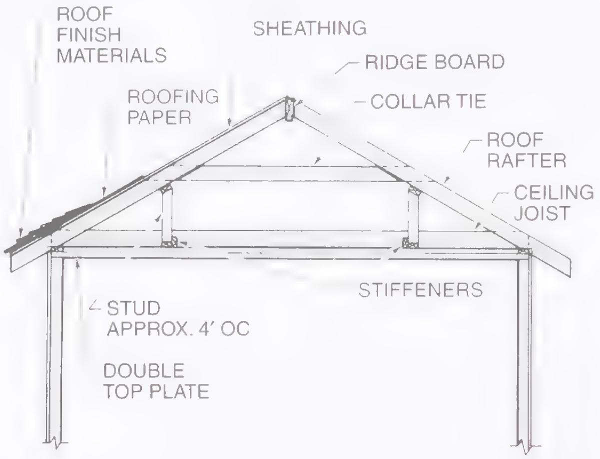


Figure 2-20. Conventionally framed roof rafters and ceiling joists require extra support to carry loads when spanning long distances.

Ceiling joists are laid out and fastened to the sides of the roof rafters. This arrangement creates a triangle that strengthens the roof design to offset wind pressures and support snow loads.

Roof rafters are cut, fastened to the ridge board, and fastened to the top plates of the walls on the layout marks next to the ceiling joists. Vertical studs and horizontal supports of purlins (extending 90° to the rafters), and collar ties (parallel with the rafters) are provided to prevent sagging of long rafters. Roof sheathing is fastened to the top of the rafters with the face grain at 90° to the rafters. Roofing paper and roof finish materials, such as shingles, are applied on top of the roof sheathing.

Roof Trusses. A roof truss is an engineered combination of structural members arranged and fastened in triangular units. A roof truss incorporates the ceiling joists, rafters, and vertical bracing into a single, structurally sound unit. Structural requirements are determined by the manufacturer and incorporated into the truss design. Truss design is based on a dynamic concept that places

some members in tension and other members in compression. See Figure 2-21. The tension and compression forces work together to support roof loads. When trusses are used, the weight of the roof bears only on the exterior walls. Load-bearing walls and partitions are not required in the interior of the house.

Truss measurements are determined by the truss manufacturer from the prints. Trusses are then prefabricated at a shop according to the print dimensions and delivered to the job site. Large trusses are set onto the walls with a crane. Smaller trusses can be lifted into place by hand. Trusses are typically set 24″ OC. Where possible, roof trusses should be placed directly over wall studs. Horizontal braces are fastened to the trusses during construction to prevent trusses from tipping. Roof sheathing and finish materials are applied in the same manner as conventionally framed roofs.

MANUFACTURED HOUSING

New housing construction is increasingly using prefabricated, manufactured components. Manufactured components are used by themselves or in combination with job-built construction systems. Prefabricated floors, walls, and roofs, as well as modular housing, have become common in all types of housing construction. Completed, modular houses are available for delivery to a building site, ready for occupancy. See Figure 2-22.

Figure 2-22. Modular houses are fabricated in a manufacturing facility and delivered to the building site ready for occupancy.

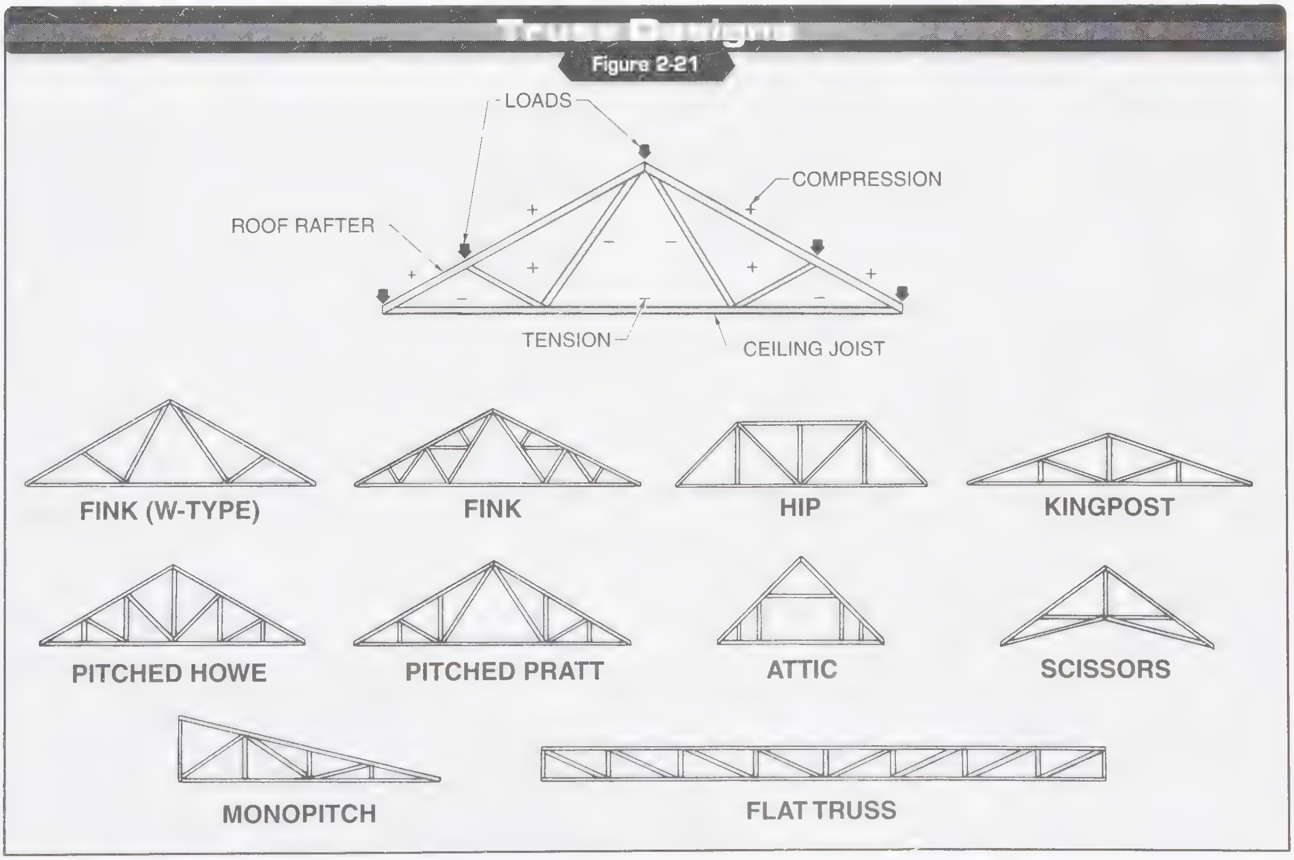


Figure 2-21. Trusses combine all necessary framing members into one self-supporting unit.

Prefabricated Components

Many designs of floor trusses, floor joists, prefabricated walls, and roof trusses have been developed to meet a wide variety of construction situations. Prefabricated components may be used with platform framing and balloon framing, or they may be used independently of other types of components.

An erection plan is provided with manufactured component houses. Floor, wall, and roof components and the corresponding plan are marked at the time of manufacture with a letter and number code. The size and number of components placed on a trailer is determined by the available transportation and job site accessibility. Tradesworkers at the job site place, assemble, and fasten the components according to the erection plan and the corresponding marks on the manufactured components.

Transport Provisions. Manufactured components are delivered to a job site by truck. The trucks may have open or closed trailers, depending on the type of components being delivered. In some instances, a truck with a crane attachment is used to unload and place the components. Small components may be unloaded and set in place by hand.

Floor Systems. Three types of prefabricated floor systems are manufactured. One type of prefabricated floor system is constructed with solid or prefabricated wood floor joists that are covered with a plywood or oriented strand board subfloor. These prefabricated floor systems are constructed in large sections using platform framing techniques. At the job site, the floor panel sections are set directly in place on the foundation with a crane and fastened together.

The other two types of floor systems use prefabricated joists. One type of prefabricated joist, known as a wood I-joist, consists of top and bottom flanges and webs that fit into grooves machined in the flanges. The flanges are solid lumber or laminated veneer lumber (LVL) and the webs are plywood, OSB, or LVL. The other type of prefabricated joist, known as a 4 × 2 floor truss, consists of 2 × 4 top and bottom chords tied together with 2 × 4 webs. The webs are fastened to the top and bottom chords with metal connector plates. Joist size and shape depend on the load to be supported and the distance to be spanned. Wood I-joists and 4 × 2 floor trusses are set in place by hand or by crane, depending on the size of the prefabricated components.

Wall Systems. Prefabricated wall systems use platform framing techniques to construct large finished wall sections. The wall sections are constructed on worktables in a manufacturing facility. Manufacturing tables with hydraulic clamps aid in properly laying out studs, positioning top and bottom plates, and securing these members in position during assembly. The wall components are fastened together with staples and nails driven by pneumatic tools. Windows, exterior sheathing, and siding may be attached to the wall sections. Hangers are attached to the top of each wall section to provide an attachment point for the crane lifting them into place at the job site. Wall sections are marked with letters and numbers and set on the floor according to the manufacturer's layout marks.

Roof Systems. Prefabricated roof trusses are the most common prefabricated components used in residential construction. Roof trusses are manufactured for each type of roof. Roof trusses are typically constructed with 2 × 4s or 2 × 6s joined with metal connector plates. Roof truss design is based on anticipated wind and snow loads for a particular area and on the interior ceiling design.

Roof trusses are typically hoisted by crane into the upright position and placed across the top plates.

Mobile Homes

Mobile homes are the primary type of manufactured housing. Mobile homes are completely built in a manufacturing facility and delivered to the building site ready for occupancy.

Construction. Mobile homes are constructed in accordance with federal standards contained in a building code developed by the Department of Housing and Urban Development (HUD). Maximum strength with a minimum of weight is a primary concern in the construction of a mobile home. Smaller building components are frequently used to meet structural standards while keeping the weight of the overall structure to a minimum. Framing is performed on manufacturing tables that secure studs

and plates in position for fastening. The base of a mobile home rests on a steel frame that is also used as the trailer support for the home. After framing is complete, sheathing, siding, electrical wiring, insulation, heating and cooling systems, and plumbing fixtures are installed. Interior finish materials are applied at the manufacturing facility, including cabinetry, finish flooring, and trim moldings.

Finished mobile homes are transported by truck to the building site. Mobile homes are anchored to a foundation of a concrete slab-on-grade, piers, or a conventional foundation with a basement. The mobile home is then connected to the existing electrical, natural gas, and sewer systems as available.

Transport Provisions. Transporting completed mobile homes is more difficult than transporting smaller prefabricated building components. Special licenses are required for trucks moving mobile homes. Exposed interior building sections are protected with plastic sheets to prevent damage during transportation. Sufficient access is required at the building site to accommodate the movement of large vehicles.

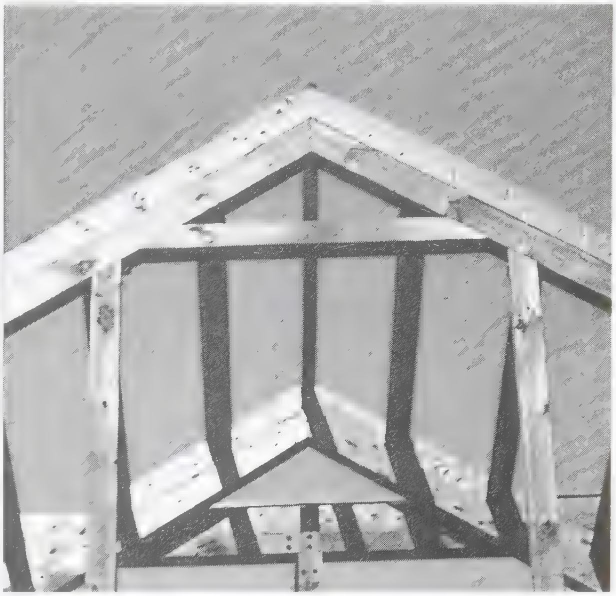
Footings for mobile homes must extend a minimum of 12″ below finish grade unless a greater depth is recommended by a foundation investigation.

POST-AND-BEAM FRAMING

In post-and-beam framing, large wood members are used to frame the house to create large open spaces within the house. See Figure 2-23. The framing members may be solid wood or engineered wood products such as glulam or LVL. Framing members are set far apart and fastened together with metal connectors, bolts, and other heavy-duty fasteners. Glulam and LVL members exhibit a minimal amount of warping and splitting and are preferred over solid members. Glulam members are manufactured using small planks joined together by a strong bonding adhesive.

Floor Systems

Post-and-beam floors consist of solid or engineered wood beams placed over posts that are supported by concrete piers. The beams are secured to posts using metal connectors. The prints indicate proper post and beam spacing, which is typically 2′ to 4′ OC. The subfloor for a post-and-beam house is typically 2″ thick tongue-and-groove planks to provide additional strength for spanning wide beam spacing. Post-and-beam floors may also be constructed using 1⅛″ thick tongue-and-groove OSB or plywood panels.



Classic Post & Beam

Large wood members are used to frame a post-and-beam house.

Kolbe & Kolbe Millwork Co., Inc.

***Figure 2-23.** Large solid or engineered wood members are used to frame a post-and-beam house to create large open spaces within the house.*

Wall Systems

Posts for post-and-beam walls are set according to print dimensions and are typically spaced 4′ OC or wider. Posts require special foundation provisions because of the concentration of weight. A bottom plate is secured to the tops of the floor beams around the perimeter of the house. Posts extend vertically from the bottom plate to a top plate. Large windows are commonly used with post-and-beam framing to accentuate the openness of the design. Spaces between exterior wall posts and interior partitions are framed using platform or balloon framing techniques.

Roof Systems

The main structural members of a post-and-beam roof are the exposed ridge beam, roof beams, and planks used for covering the roof. The ridge beam and roof beams are solid wood or engineered wood members. Roof beams may extend parallel or perpendicular (90°) to the ridge beam. Planks used to cover the roof are available in 1½″, 2½″, or 3½″ thicknesses with tongue-and-groove edges. When the planks are to be exposed on the interior of the building, a vapor barrier and rigid insulation is installed on the upper side of the roof planks.

METAL FRAMING

Light-gauge metal framing members are lightweight, straight, strong, and are fire-, decay-, and insect-resistant. Several types and sizes of light-gauge metal framing members are used in the construction of floors, walls, and roof trusses. The framing members have openings formed in the webs to accommodate electrical cables and plumbing pipes. Light-gauge metal framing members are available in thicknesses ranging from 12 ga (gauge) to 20 ga. Higher gauge numbers indicate thinner steel members.

Local building codes provide information regarding the use of metal framing members for residential, light commercial, and commercial usage. Local building codes may require certain on-center spacing distances and fastening methods for metal framing members.

For large housing developments, metal framing members may be precut and delivered to the job site ready to assemble and fasten. Some metal framing members may require cutting on the job site.

Floor Systems

Floors for a metal-framed house are supported by a foundation in a similar manner to a wood-framed house. Foundation walls and supporting beams are set in place at the elevation specified in the prints. C-shape joists are then set horizontally on the foundation and supporting beams at the spacing indicated on the prints. C-shapes are available in standard sizes with flanges varying from 1⅝″ to 2½″ and webs varying from 5½″ to 12″. See Figure 2-24. A rim track is fastened to the ends of the joists with a bearing stiffener using self-tapping screws or by welding. An anchor bolt and clip angle secures the rim track to the foundation wall. The subfloor is then installed over the top flange of the C-shape joists using self-tapping screws.

Wall Systems

The construction of a metal-framed wall is similar to the construction of a wood-framed wall. A metal-framed wall consists of top and bottom tracks (similar to top and bottom plate in a wood-framed wall) and studs. Tracks are continuous members without preformed holes and lips. Tracks and studs are available with standard flange widths ranging from 1¼″ to 1⅝″ and standard web depths from 2½″ to 8″. The most common web depths for metal tracks and studs are 3½″ and 5½″ to allow door and window frame installations, which also fit into a 2 × 4 or 2 × 6 wood-framed wall. See Figure 2-25.

Metal stud walls are typically constructed on the subfloor and raised into position. Studs are placed into the tracks and fastened to the tracks with self-tapping screws or by welding. On-center spacing of light-gauge metal studs is specified on the prints in accordance with the local building code. Typically, metal studs are spaced 16″ or 24″ OC, depending on the imposed loads.

Light-gauge metal framing members are typically cut with aviation snips.

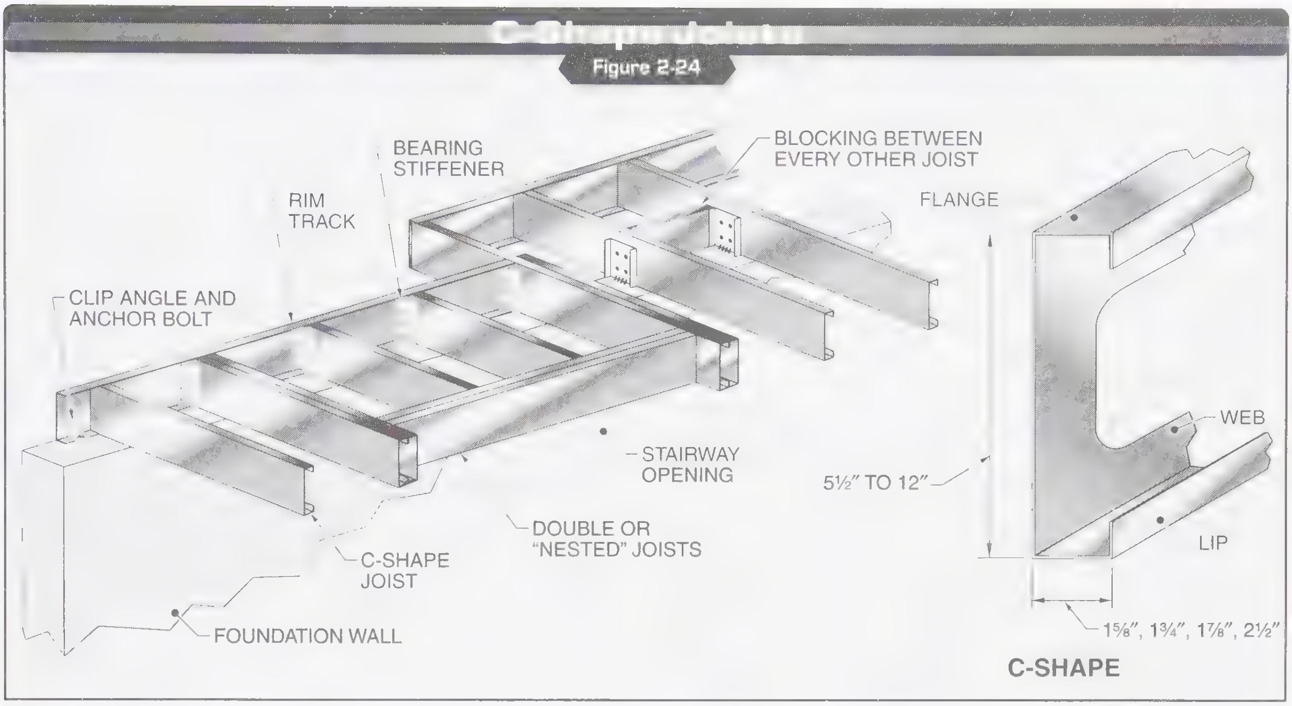


Figure 2-24. *Floors for a metal-framed house are supported by a foundation in a similar manner to a wood-framed house. Clip angles and anchor bolts secure the rim track to the foundation walls.*

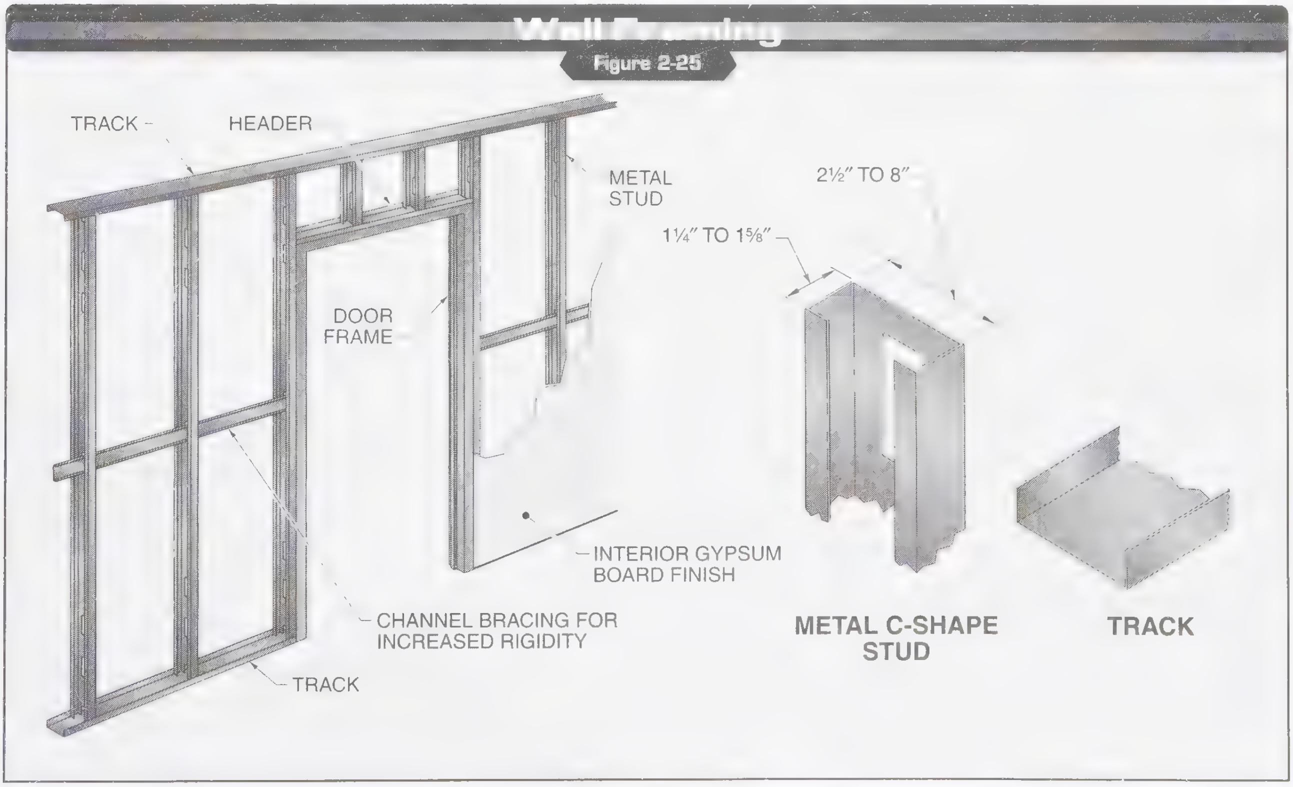


Figure 2-25. *Metal-framed walls utilize top and bottom tracks, C-shape studs, and horizontal headers in a manner similar to wood framing.*

Similar to a wood-framed load-bearing wall, exterior metal-framed walls must be properly braced to provide adequate lateral stress reinforcement. Metal strapping may be applied diagonally to the exterior edges of metal framing members prior to applying exterior sheathing. Exterior sheathing is fastened to the exterior of the metal framing members with self-tapping screws. After exterior bracing and sheathing are installed, walls are raised into place and braced. Additional horizontal bracing may be placed through the preformed holes in the studs to further strengthen the metal framework.

Framed Openings. Where openings are required in floors and walls, heavier gauge members may be required around the opening perimeter. For example, a wall framed with 18 ga metal studs may have a 14 ga metal stud installed at each side of a window opening to support the additional imposed loads.

Headers, rough sills, and cripple studs are installed in a similar manner as a wood-framed house. The flanges of these members may be cut and bent to provide attachment points for adjacent members.

Roof Systems

The framework of a metal-framed roof is commonly constructed of light-gauge metal C-shapes that have been cut and formed into roof trusses. See Figure 2-26. Roof framing members are fastened together using self-tapping screws or by welding. Metal gussets may be used to reinforce the truss joints.

TrusSteel® Div. of Alpine Engineered Products, Inc.

Figure 2-26. Metal trusses are constructed using C-shapes that are fastened together using self-tapping screws or by welding.

Care must be taken when positioning metal trusses on a house. Since the trusses are constructed with light-gauge members, they have a tendency to bend if not properly handled. Proper use of rigging lines and lifting equipment is necessary for placement without structural damage to the truss.

After the trusses are lifted into place, they are fastened to the top tracks with clip angles and self-tapping screws or by welding. Diagonal bracing is installed to secure the trusses in alignment. Roof sheathing is fastened in a manner similar to the subfloor by driving self-tapping screws through the flanges of the light-gauge framing members.

Interior Finish

Residential interior walls are commonly finished with gypsum board. The gypsum board is fastened to the framing members using drywall screws, nails, and/or adhesives. Door and window frames are also fastened to the framing members. Wood trim members, such as baseboard and casing, are fastened to the metal frames with trim screws. Trim screws are self-tapping screws with small heads that create a small hole that is easily filled and painted.

MASONRY

Many older homes are constructed with solid masonry exterior walls. The use of solid masonry for residential walls has diminished because solid masonry provides minimal insulating abilities. Brick-veneer walls are more common in contemporary residential construction.

Solid Masonry

Solid masonry walls are constructed using brick and concrete masonry units (concrete block). Solid masonry walls provide minimal insulating properties because the composition structure of the materials is very dense. See Figure 2-27. Dense materials transmit heat and cold more readily than materials that have air spaces, which reduce thermal transmission.

Utilities are installed in the proper location according to the prints before courses of masonry are laid. Doorjambs are set in position and braced to be level and plumb before masonry is laid. Window jambs are set in position as wall construction proceeds. Steel or stone lintels are set over openings to support the weight of the masonry above.

Type N mortar is the most common type of mortar used in residential construction.

When constructing a solid masonry wall, the corners of the wall are built up first to provide a reference for bricklayers. The courses of masonry are then laid between the corners. A variety of brick bonds (patterns) are used in laying solid brick walls. Courses of concrete masonry units may be laid along the inside of the wall to create a base for a brick or stone facing to be applied to the exterior surface of the wall. See Figure 2-28.

R VALUES OF COMMON BUILDING MATERIALS

Material or Product	R Value	
	Per 1″ Thickness	Per Thickness Shown
Concrete	0.08	
Face brick	0.11	
Hollow concrete masonry units, 8″		1.11
Stucco	0.20	
Metal lath & plaster, ¾″		0.13
Gypsum board, ⅜″		0.32
Gypsum board, ½″		0.45
Plywood, ⅜″		0.47
Plywood, ½″		0.62
Plywood, ¾″		0.93
Pine, fir, other softwoods	1.25	
Oak, maple, other hardwoods	0.91	
Asphalt shingles		0.44
Wood shingles		0.94
Fiberglass batts, 3″ to 4″		11.00
5″ to 6″		19.00 INSULATION
6½″ to 7″		22.00 MATERIALS
8½″ to 9″		30.00
Expanded polystyrene, 1″		3.57
Inside surface air film*		0.68
Outside surface air film†		0.17
Air space, ¾″, nonreflective‡		1.01
Air space, ¾″, reflective‡		3.48

* heat flow horizontal, still air
† heat flow any direction, 15 mph wind
‡ heat flow horizontal

Figure 2-27. A lower R value indicates less insulating properties. Dense materials, such as masonry and concrete, have a low R value and provide minimal insulation.

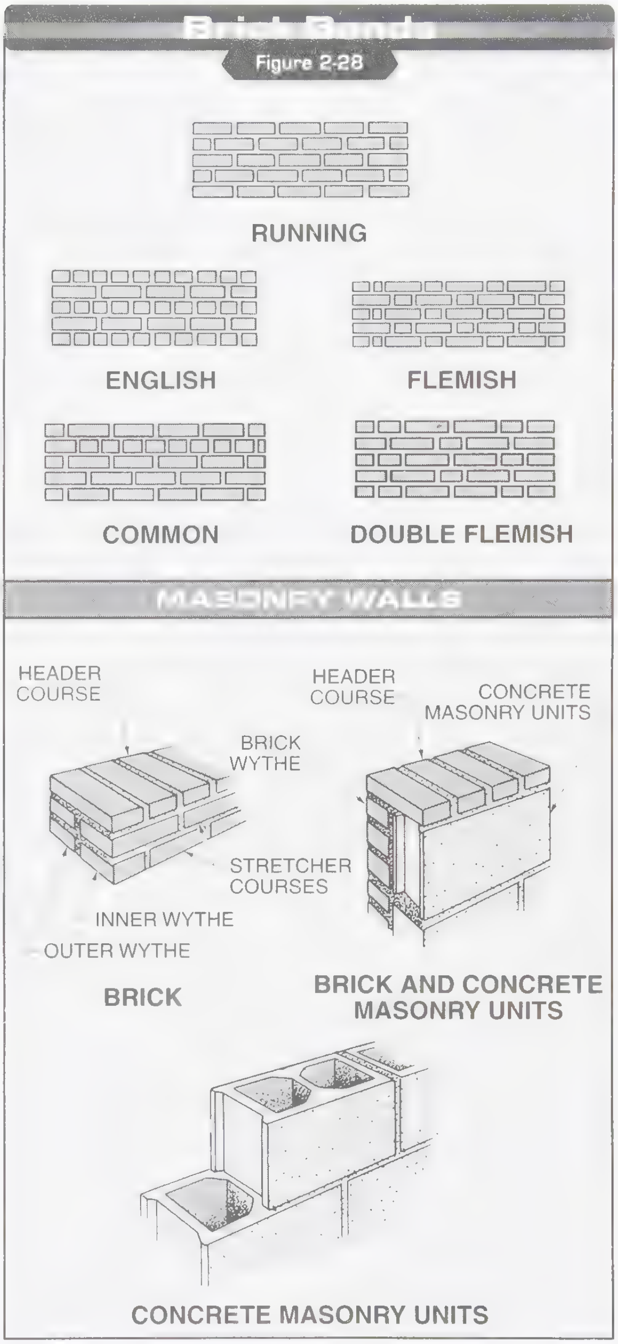


Figure 2-28. Various brick bonds may be used to provide a desired appearance. Masonry walls can be constructed of solid brick, brick and concrete masonry units, or hollow-core concrete masonry units.

Wood or metal furring is fastened directly to the interior face of the masonry wall. The furring is then finished with common interior finish materials such as gypsum board or wood paneling. Depending on the application, a vapor barrier and/or insulation may be placed between the masonry wall and the finish materials. Interior walls are typically framed using platform

framing techniques. Interior solid masonry walls are uncommon in residential construction due to the weight of the masonry materials.

Masonry is commonly used in residential construction for fireplace construction. The masonry materials are set on a concrete base. Materials required for the construction of a solid masonry fireplace are firebrick, flue tile, concrete masonry units or common brick, and the fireplace facing material, which can be brick, concrete masonry units, or stone. Masonry materials may also be used as a veneer for a prefabricated metal firebox and flue system.

Masonry Veneer

Masonry veneer construction combines the advantages of a maintenance-free and durable exterior finish with the insulation properties achieved when using conventional platform or balloon framing. Framing members are set back from the exterior edge of the foundation to provide room for the masonry materials to be laid directly on the foundation. See Figure 2-29. Masonry veneer courses are laid after floor and wall framing are completed and windows and doors have been installed.

Masonry veneer corners are laid first to provide a reference for all courses between the corners. A 1″ air space provided between the back of the masonry materials and the face of the wall framing members improves insulating properties, allows for separate expansion and contraction of the masonry materials and the framing members, and provides room for condensation to form without entering the house. Metal ties secure the masonry veneer and framing members together. The ties are fastened to the wall studs and set into the horizontal mortar joints at 2′ to 3′ intervals in both directions.

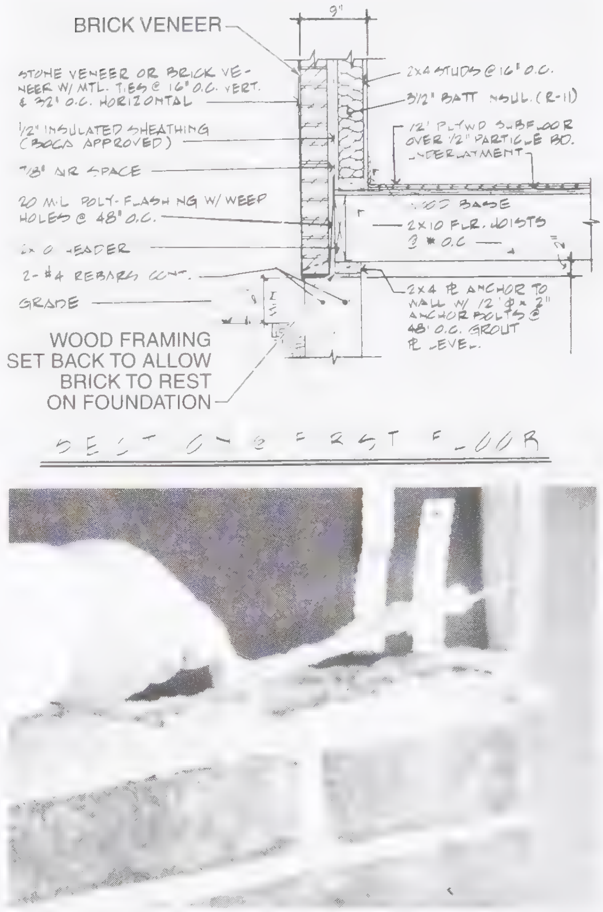


Figure 2-29. Brick veneer is fastened to the exterior face of wood-framed walls using metal ties.

CONCRETE

Concrete used in residential structures is not limited to use as a foundation material. Concrete is used for floors, walls, and roofs in houses built above and below ground. Earth-sheltered houses use concrete as a decay- and insect-resistant material since the floors, exterior walls, and roofs come into direct contact with the soil.

> *Concrete is a mixture of cement, fine and/or coarse aggregate, and water. Cement acts as the bonding agent in concrete when mixed with water.*

Floor Systems

Two construction systems—slab-on-grade and beam-and-slab—are used for concrete floor construction. A slab-on-grade is used as a basement floor or in houses where there will not be a basement. A beam-and-slab concrete floor provides clear, open areas below the floor. See Figure 2-30.

Slab-on-Grade. When a slab-on-grade is used as a basement floor, the foundation walls are first constructed. The foundation walls may be concrete or concrete masonry units. Utilities are then stubbed in. After the concrete or mortar of the foundation walls has set sufficiently, the ground below the slab is compacted and gravel is added and leveled. A vapor barrier is placed over the gravel, and steel reinforcement, such as rebar or welded wire reinforcement, is set into position. Concrete is then placed to form the slab-on-grade.

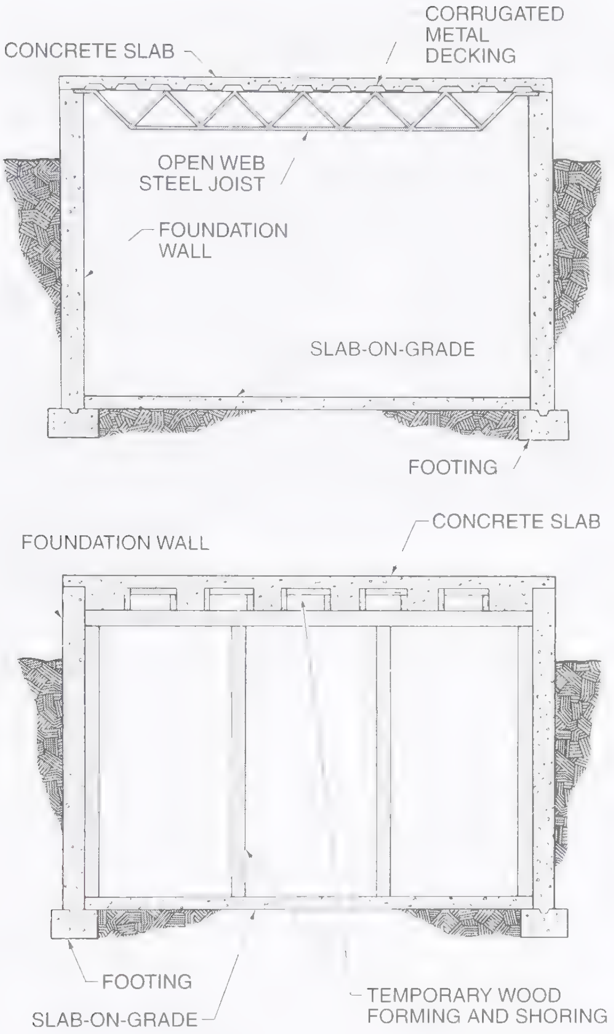


Figure 2-30. A concrete slab over open web steel joists and beam-and-slab construction are used for elevated concrete floors.

For slabs-on-grade that are not a basement floor, the ground is leveled and forms are set around the perimeter of the floor area to retain the proper dimensions of the concrete. Utilities are stubbed in before concrete is placed. Gravel, a vapor barrier, steel reinforcement, and rigid insulation are set in place on the ground, and concrete is placed in the forms.

Beam-and-Slab. Beam-and-slab construction is more common in commercial buildings but may also be used in residential construction. Steel, cast-in-place concrete, or precast concrete is used as joists. Corrugated metal decking is set on top of the joists, or removable forms are set between the joists to retain the concrete. Concrete for the beams and floor may be placed at the same time or at separate times. Beam-and-slab construction is also used to form concrete roof deck slabs for earth-sheltered houses.

Wall Systems

Concrete walls provide maximum strength and decay resistance. Concrete walls are used below grade for earth-sheltered houses or as foundations for conventional houses. However, concrete walls provide poor insulating abilities because of their density.

Foundations. Concrete foundation walls and walls for earth-sheltered houses are cast in place. Forms are set in the proper position, window and door jambs are installed, and steel reinforcement is set in place before concrete is placed. See Figure 2-31. After the concrete has set sufficiently and the forms are stripped, a waterproofing material is applied to the exterior surface of the wall below the finish grade. Waterproofing materials may include liquid membranes that are sprayed onto the wall, self-adhesive asphalt sheet membranes, or rigid foundation insulation panels that adhere to the wall to make it more watertight. If the walls are part of an earth-sheltered house, extra precautions are taken to prevent moisture from penetrating the walls.

Figure 2-31. Prefabricated wall forms are commonly used in residential construction to form concrete walls.

The interior surface of a concrete foundation wall is finished in a similar manner as a solid masonry wall, by fastening wood or metal furring to the concrete and installing gypsum board or wood paneling over the furring. A framed wall may also be constructed on the interior side of the concrete foundation wall and finished with gypsum board or wall paneling. As an alternative, a plastered or painted finish may be applied directly to the foundation wall.

Above-Grade Walls. Above-grade concrete walls are cast in place in a similar manner as below-grade foundation walls. Blockouts for utilities extending through exterior walls are installed between the form walls before concrete is placed in the forms. The appearance of the exterior concrete surface may be improved with the use of decorative forms or form liners. The interior surface of the wall is furred and covered with gypsum board, wood paneling, or other interior finish material.

TUFF-N-DRI

Rigid foundation insulation panels are applied over liquid membranes to make concrete walls more watertight.

REVIEW QUESTIONS

CHAPTER 2

Types of Residential Construction

Name ______________________________ Date ______________

Completion

______________ **1.** Three types of bridging are ___, ___, and ___ bridging.

______________ **2.** Second-floor joists of a balloon-framed house are supported by ___ at the exterior walls.

______________ **3.** A steel or stone ___ is installed over masonry openings to support the weight above.

______________ **4.** Brick-veneer walls are attached to framing members with ___.

______________ **5.** Two construction systems used for concrete floors in residential construction are ___ and ___.

______________ **6.** Strips of ___ are placed between the foundation and sill plate.

______________ **7.** Another term for header joist is ___.

______________ **8.** Roof trusses are typically placed ___″ OC.

______________ **9.** ___ or ___ is commonly installed as a subfloor in a platform-framed house.

______________ **10.** A(n) ___ is sprayed on concrete foundation walls for waterproofing.

______________ **11.** A(n) ___ provides intermediate support for floor joists where there is a long span between foundation walls.

______________ **12.** The vertical member used to support a header on each side of an opening is a(n) ___.

______________ **13.** The ___ is the number of inches that a rafter rises vertically for every foot of unit run.

______________ **14.** A(n) ___ roof slopes in one direction only.

______________ **15.** The actual thickness of a 2 × 4 is ___″.

______________ **16.** The minimum slope for a flat roof is ___″ unit rise for each 12″ of unit run.

______________ **17.** The ___ is the horizontal member at the peak of a roof that provides a nailing surface for the upper ends of the common rafters.

Multiple Choice

______ 1. Sizing and spacing of floor joists is based on ___.
A. cost
B. distance spanned and load supported
C. beam length
D. all of the above

______ 2. Plywood and OSB subfloor panels are installed with the face grain ___ to the floor joists.
A. parallel
B. at 45°
C. at 90°
D. none of the above

______ 3. A hip roof slopes in ___ direction(s).
A. one
B. two
C. three
D. four

______ 4. The base of a mobile home rests on a(n) ___.
A. steel frame
B. wood platform
C. OSB subfloor
D. none of the above

______ 5. Light-gauge metal framing members are ___.
A. lightweight
B. insect resistant
C. fire resistant
D. all of the above

______ 6. The bottom plate in a platform-framed wall is also referred to as the ___.
A. sole plate
B. sill plate
C. header
D. ridge board

______ 7. ___ prevent fire from spreading inside walls by impeding the airflow in the open channel between studs.
A. Insulating materials
B. Fire blocks
C. Furring channels
D. all of the above

______ 8. Posts for post-and-beam walls are typically spaced ___′ or wider.
A. 2
B. 4
C. 8
D. 16

______ 9. Corners of masonry walls ___.
- A. are laid first for reference
- B. support all lintels
- C. cannot be plumbed until the walls are completed
- D. are usually laid last

______ 10. ___ framing utilizes a ribbon board to support upper-level floor joists.
- A. Platform
- B. Balloon
- C. Post-and-beam
- D. none of the above

Identification

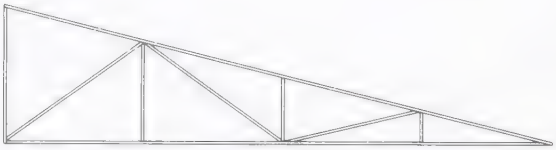
______ 1. Kingpost truss

______ 2. Monopitch truss

______ 3. Fink (W-type) truss

______ 4. Scissors truss

______ 5. Hip truss



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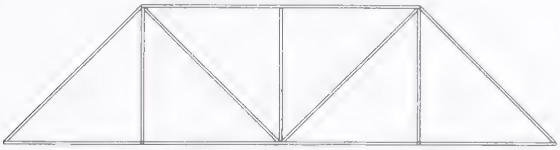

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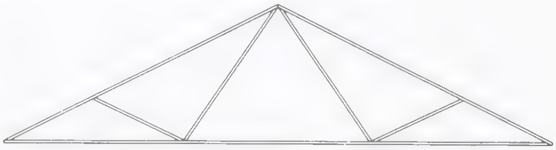

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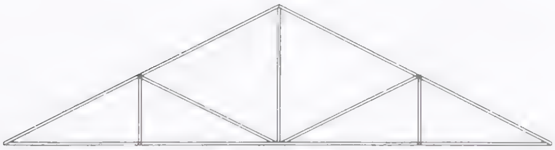

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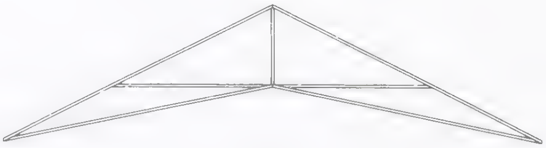

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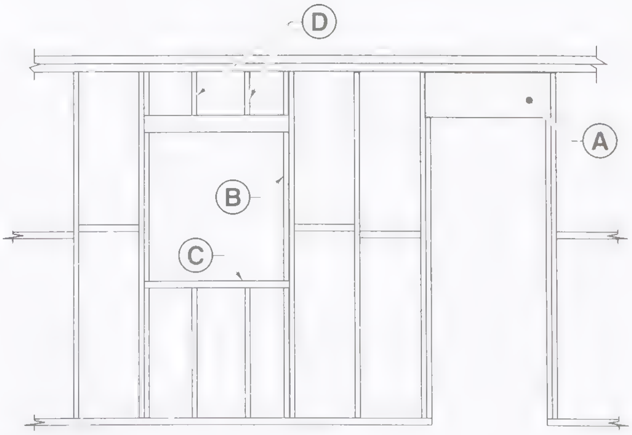
______ 6. Cripple stud

______ 7. Sill

______ 8. Header

______ 9. Trimmer stud



______ 10. Sill plate

______ 11. Double top plate

______ 12. Header joist

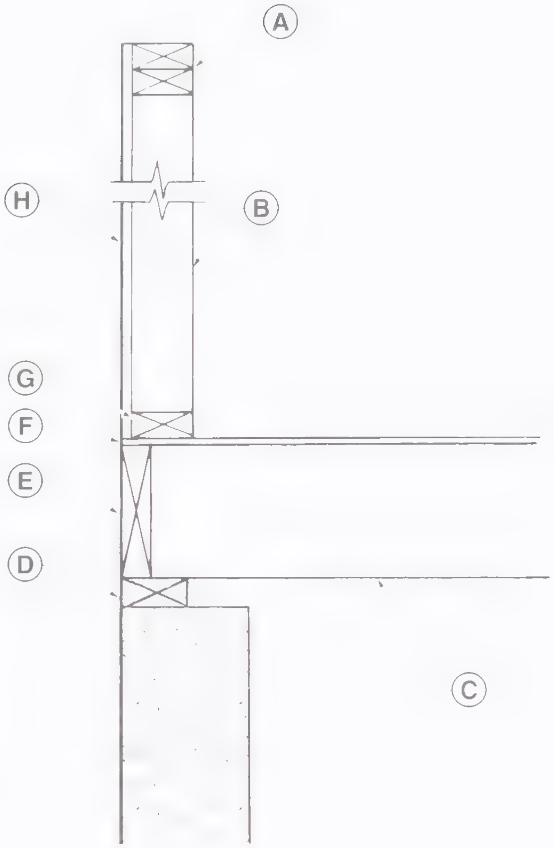
______ 13. Bottom plate

______ 14. Stud

______ 15. Floor joist

______ 16. Subfloor

______ 17. Exterior sheathing



______ 18. Flat roof

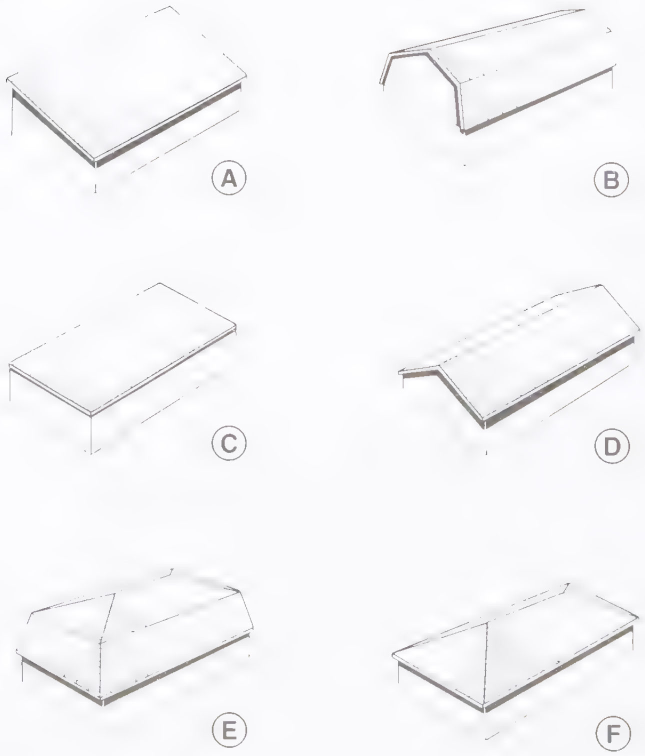
______ 19. Shed roof

______ 20. Mansard roof

______ 21. Gambrel roof

______ 22. Gable roof

______ 23. Hip roof



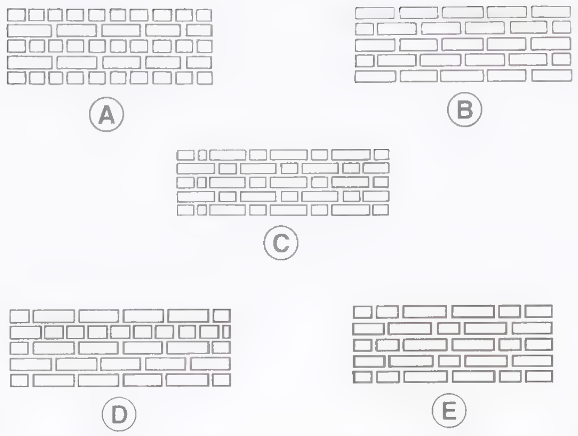
______ 24. Running bond

______ 25. Flemish bond

______ 26. Common bond

______ 27. Double Flemish bond

______ 28. English bond



______ 29. Ceiling joist

______ 30. Total span

______ 31. Unit run

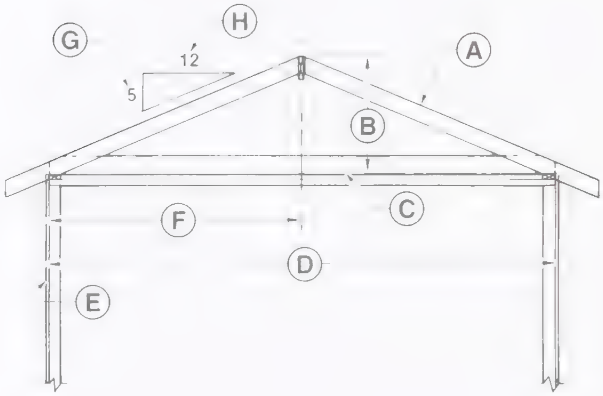
______ 32. Common rafter

______ 33. Total run

______ 34. Exterior wall

______ 35. Unit rise

______ 36. Total rise



Matching

______ 1. Ceiling joist

______ 2. Common rafter

______ 3. Purlin

______ 4. Hip jack rafter

______ 5. Roof truss

A. length is determined by framing square, tables, or measurement

B. combines all roof components into one unit

C. attaches to underside of rafter to provide additional support

D. bottom member of triangular support in conventional roof framing

E. extends between the hip rafters and the tops of the exterior walls

True or False

T F 1. Balloon framing is the most common residential framing method.

T F 2. A double top plate is used for platform-framed load-bearing walls.

T F 3. Specially treated lumber or other noncombustible materials are used for fire blocks.

T F 4. Balloon framing minimizes the effects of lumber shrinkage.

T F 5. A slope diagram indicates the total rise (in feet) in relation to the total span.

T F 6. Wall bracing is required when exterior gypsum board or expanded foam panels are installed as exterior sheathing.

T F 7. Housewrap is installed over roof sheathing to prevent water and air penetration in a house.

T F 8. Ceiling joists are fastened to the sides of roof rafters to strengthen the roof design.

T F 9. Collar ties extend parallel with the roof rafters.

T F 10. Joist hangers provide support at the butt joints between floor joists and header joists.

T F 11. Headers for openings in load-bearing and non-load-bearing walls are framed in the same manner.

T F 12. A wood I-joist is fabricated from multiple layers of solid lumber.

T F 13. All weight in a trussed roof system bears only on the exterior walls at each end of the truss.

T F 14. Masonry walls provide better insulation than wood-framed walls.

T F 15. Metal studs are typically spaced 16″ or 24″ OC.

Chapter 3

Dimensioning

Lines and dimensions on a print convey information about the shape and size of a building lot, construction components and methods, layout of rooms, and overall house design. An owner reads the prints and interprets the dimensions and lines to determine the suitability of the house size and design. The local building commissioner's office reviews the prints to ensure the house will comply with all applicable building code requirements. Contractors develop building schedules and cost estimates for labor and materials based on dimensions shown on the prints. Tradesworkers read the prints and interpret the dimensions and lines to build the house as it is shown on the prints.

Dimensions are expressed using various methods. The dimensioning method used for a particular drawing is based on the type of drawing. For example, feet, inches, and fractions of an inch are typically used on a floor plan, while decimal dimensions are commonly used on a plot plan. Several common line types are used on drawings, including object lines, dimension lines, and centerlines. Utilities, such as electrical cables and plumbing pipe, are indicated on drawings with special line types.

DIMENSIONS

Tradesworkers interpret scaled dimensions from prints to construct full-size building components. U.S. customary (English) fractional or decimal dimensions are commonly used to denote sizes on prints.

Drawings of a house and its components are created at a reduced scale to allow all components and structural members to be shown on a manageable-size sheet of paper. The most common scale used for residential prints is ¼″ = 1′-0″ where one-quarter inch on the prints equals one foot of actual measurement. The scale for a particular drawing depends on the size of the object being shown. Drawing scales range from 3⁄32″ = 1′-0″ to full scale (1″ = 1″ or 1′-0″ = 1′-0″).

Fractional Dimensions

U.S. customary fractional dimensions are expressed in feet, inches, and fractions of an inch. Fractional dimensions are the most common type of dimension shown on residential prints. See Figure 3-1. Yards, rods, and other linear units of the U.S. customary system of measurement are not used when dimensioning residential prints.

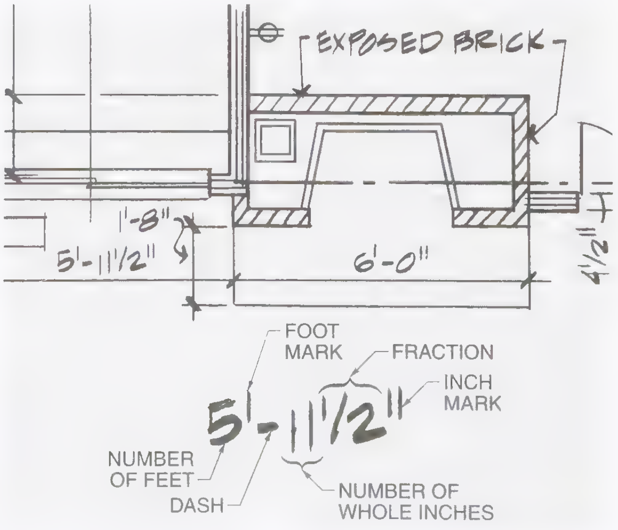


Figure 3-1. Feet, inches, and fractions of an inch are common dimensions in the U.S. customary system.

Feet. The foot is the largest unit of measurement used for residential plans. Feet are shown on prints as a digit or several digits followed by the foot mark (′). For example, 3′ indicates a measurement of three feet. The abbreviation "FT" may also be used to represent foot or feet. For example, 4 FT represents four feet.

Inches. A foot is divided into 12 equal parts, or inches. Each inch is one-twelfth of a foot. Dimensions less than one foot are shown as inches and fractions of an inch. An inch measurement is shown using a digit followed by the inch mark (″). For example, 7″ indicates a measurement of seven inches. Six and one-half inches is shown as 6½″.

A dash is used to separate feet from inches where feet and inches are used together. For example, three feet, six inches is expressed as 3′-6″. Four feet, three and one-quarter inches is expressed as 4′-3¼″. Zero inches is shown wherever the dimension is a whole foot measurement or when full inches are not shown. For example, a measurement of four feet is shown as 4′- 0″. A measurement of ten feet, one-half inch is shown as 10′-0½″.

Decimal Dimensions

On residential prints, decimal dimensions are based on tenths and hundredths of a foot. Smaller subdivisions, such as thousandths or ten-thousandths, may be used for more precise measurements. The number of places to the right of the decimal point indicates the unit of measurement. For example, one-tenth of one inch is expressed as .1″ and one one-hundredth of an inch is expressed as .01″.

Decimal dimensions are typically used when working with digital surveying equipment such as total station instruments.

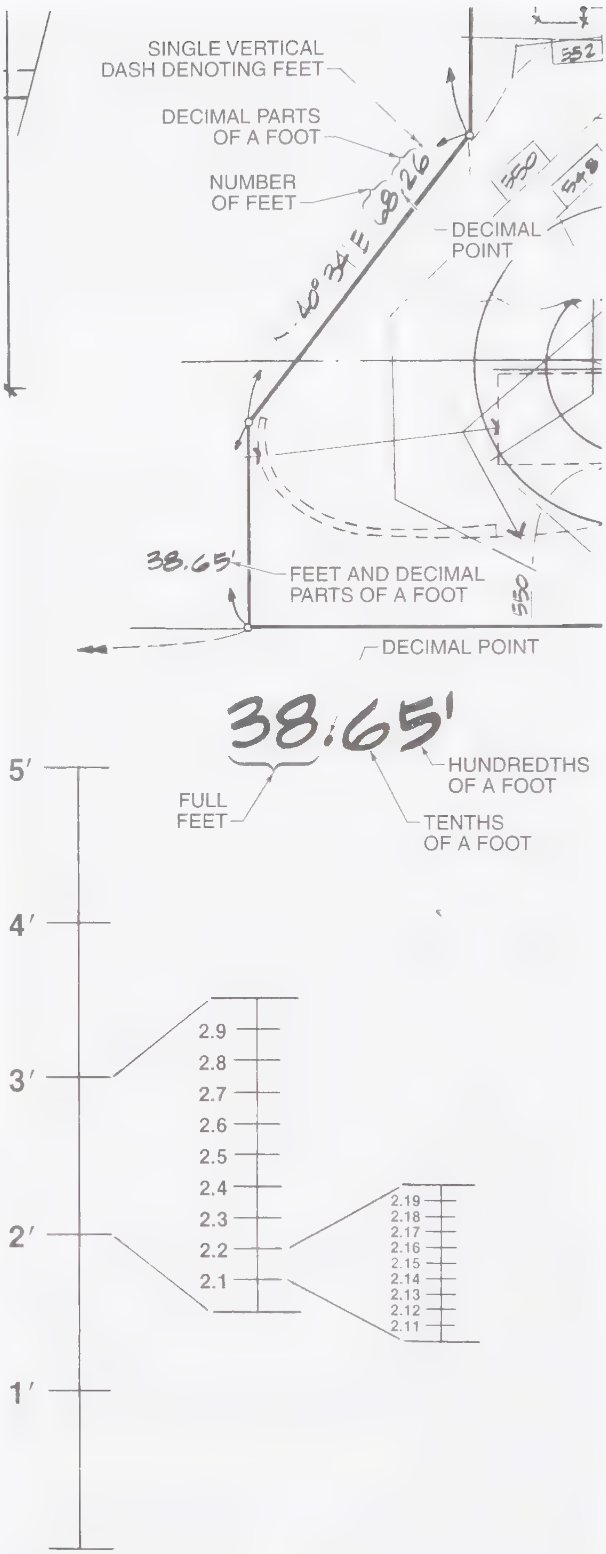


Figure 3-2. A foot is divided into 100 equal sections to form decimal parts of a foot. Larger and smaller divisions are also possible.

Feet. When decimal dimensions are expressed as hundredths, one foot is divided into 100 equal sections. Each of these sections is equal to one one-hundredth of a foot (.01′). Hundredths of a foot are used to express values between .00′ and 1.00′. For example, .56′ indicates a measurement of fifty-six hundredths of a foot. Decimal dimensions are typically used on residential prints to indicate heights and elevations of objects on a plot plan or an elevation. See Figure 3-2. A foot can also be divided into ten equal sections when a lesser degree of accuracy is required. Each section equals one-tenth of one foot (.1′). For example, .3′ indicates a measurement of three-tenths of a foot.

Dimensions less than one foot are shown as a decimal portion of a foot. The decimal portion of a foot is noted behind the full foot measurement. A decimal point (.) is placed between the full foot measurement and the decimal portion of a foot.

Dimensions such as elevations and the lengths of property lines are typically expressed in feet and hundredths of a foot. Elevation differences and distances between various points on a building lot are calculated by subtracting decimal dimensions. For example, if the highest elevation on a lot is 15.95′ and lowest elevation is 3.63′, the difference in elevations is 12.32′ (15.95′ – 3.63′ = 12.32′).

Math for Measurements

Foot and inch dimensions on residential prints may need to be added, subtracted, multiplied, and divided. Calculations involving feet are performed using the base 10 system. Calculations involving inches are performed using the base 12 system because inches are based on 12 equal divisions. Feet are converted into inches for mathematical purposes by adding or subtracting 12 units, not 10 units. Since the base 10 and base 12 systems are different systems, foot calculations (which are base 10) and inch calculations (which are base 12) must be performed separately. See Figure 3-3.

Fractions. Fractions of an inch are expressed with a numerator and a denominator. See Figure 3-4. The numerator and denominator are separated by a horizontal or inclined fraction bar. The denominator is the lower number of a fraction. For example, in the fraction ¼″, 4 is the denominator. The denominator indicates the division of the inch into equal parts. Halves (2), fourths (4), eighths (8), sixteenths (16), thirty-seconds (32), or sixty-fourths (64) are standard divisions used on residential prints. The greater the number of divisions made, the greater the degree of accuracy. One-sixteenth of an inch is the smallest division of an inch typically appearing on residential prints. Most dimensions on residential prints are expressed to the nearest ⅛″.

The numerator is the upper number of a fraction. The numerator shows the number of actual divisions that make up a length of measurement. For example, 5⁄16″ indicates an inch that has been divided into 16 equal parts (the denominator), of which the actual length of measurement is equal to 5 of those parts (the numerator).

The numerator of a fraction expressed on a print is always an odd number. If the numerator is an even number, the fraction can be reduced to simpler terms by dividing the numerator and denominator by the lowest common denominator. For example, a fraction of 4⁄8 can be divided by 4 in both the numerator and denominator to result in a fraction of ½.

Addition and subtraction of fractions require that both fractions have the same denominator (called a common denominator). The numerator and denominator of the fraction with the smaller denominator are multiplied so both denominators equal the larger number denominator. When the common denominator is determined, the numerators are added. For example, when adding ¾″ and ⅝″, both the numerator and denominator of ¾″ are multiplied by 2 to change the fraction to 6⁄8″. With a common denominator of 8, 6⁄8″ and ⅝″ are added for a total 11⁄8″, which can be reduced to 1⅜″.

Construction calculators are commonly used on a job site to perform mathematical calculations.

ADDITION

6'- 11"
+ 3'- 10"

1. ADD FEET
   6'- 11"
   + 3'- 10"
   9'-
2. ADD INCHES
   6'- 11"
   + 3'- 10"
   21"
3. CONVERT INCHES TO FEET
   21" = 1'- 9"
4. COMBINE ANSWERS FROM STEPS 1 AND 3
   9'-
   + 1'- 9"
   10'- 9"

SUBTRACTION

5'- 2"
− 1'- 7"

1. CONVERT FEET TO INCHES
   5'- 2" − 1'- 7" → 4'- 14" − 1'- 7"
2. SUBTRACT
   4'- 14"
   − 1'- 7"
   3'- 7"

MULTIPLICATION

6'- 9"
× 8

1. MULTIPLY FEET
   6'
   × 8
   48'
2. MULTIPLY INCHES AND CONVERT TO FEET
   9"
   × 8
   72"
   72" = 6'
3. ADD FEET
   48'
   + 6'
   54'

DIVISION

5) 12'- 11"

FIRST METHOD

1. DIVIDE FEET
   2'-
   5) 12'- 11"
   10
   2'- 11"
2. CONVERT REMAINDER TO INCHES
   2'- 11" = 35"
3. DIVIDE INCHES
   7"
   5) 35"
4. COMBINE ANSWERS FROM STEPS 1 AND 3
   2'- 7"

SECOND METHOD

1. CONVERT FEET TO INCHES
   12' = 144"
2. ADD INCHES
   144" + 11" = 155"
3. DIVIDE
   31"
   5) 155"
4. CONVERT TO FEET AND INCHES
   31" = 2'- 7"

Figure 3-3. Math calculations involving feet and inches require that feet and inches be calculated separately.

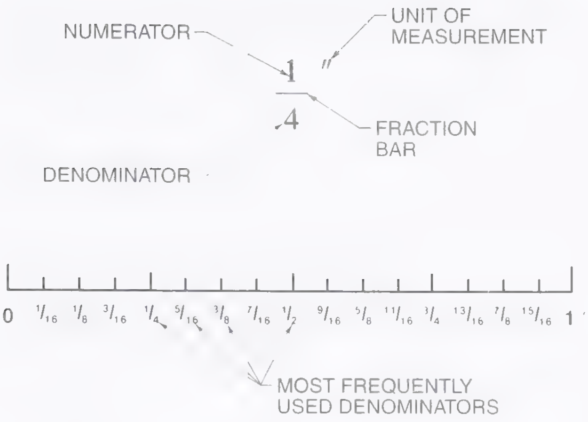


Figure 3-4. *Fractions divide inches into smaller lengths.*

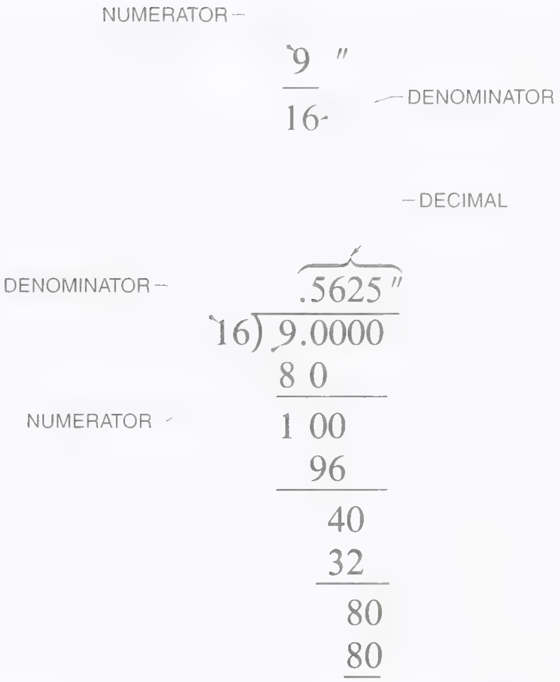


Figure 3-5. *Fractions are converted into their decimal inch equivalents by division.*

Decimals. Decimal inch dimensions are not as common on residential prints as fractional dimensions, but decimal dimensions may occasionally be associated with details of fixtures or other items. Similar to decimal parts of a foot, an inch is divided into 100 equal sections, each section equal to one one-hundredth of an inch (.01″). Divisions into thousandths and ten-thousandths may be used for a very high degree of accuracy. However, thousandths and ten-thousandths would not typically appear on residential prints.

Fractional inch dimensions are converted into decimal inch dimensions before an inch dimension can be converted into decimal parts of a foot. See Figure 3-5. Fractional inch dimensions are converted to decimal inch dimensions by dividing the numerator by the denominator. For example, 9⁄16″ is converted into a decimal inch by dividing 9 by 16 for a result of .5625″.

Inch-Decimal Conversion

The conversion of inches into decimal parts of a foot and vice versa is accomplished mathematically or by field conversion. See Figure 3-6. Mathematically, full inches and decimal equivalents of an inch are divided by 12. The resulting answer is the decimal part of a foot. For example, 5¾″ is first changed to decimal parts of an inch (5.75″) and then divided by 12. The result of .479′ is the decimal equivalent in feet.

Field conversion is not as exact as the mathematical method, but it is sufficiently accurate for residential construction and faster than the mathematical method. Five accuracy points throughout a foot measurement provide memory guides. The accuracy points are 0″ (.00′), 3″ (.25′), 6″ (.50′), 9″ (.75′), and 12″ (1.00′).

Field conversion assumes that each one-eighth of an inch equals one hundredth of a foot (⅛″ = .01′). In addition, each full inch is assumed to equal eight hundredths of a foot (1″ = .08′). The addition or subtraction of .01′ for each ⅛″ and .08′ for each 1″ from the closest of the five accuracy points results in an accurate dimension anywhere throughout the length of a foot by performing simple mathematical calculations. For example, field conversion can be used to convert 4¼″ from fractional inches to a decimal foot dimension. The closest accuracy point to 4″ is 3″. Three inches equals twenty-five hundredths of a foot (3″ = .25′). Eight hundredths (.08′) is added for each 1″ variance from an accuracy point (.25′ + .08′ = .33′; .33′ = 4″). One-quarter inch (which can also be expressed as two-eighths) is equal to two hundredths of a foot (¼″ = 2⁄8″ = .02′). Therefore, 4¼″ is equal to .35′ (.33′ [4″] + .02′ [¼″] = .35′).

Decimals are calculated on a base 10 system. In a base 10 system, decimals are converted to fractions by placing the number(s) to the right of the decimal point over 10, 100, 1000, or another base 10 unit. For example, .625 is converted to 625⁄1000, which can be reduced to lowest terms of 5⁄8.

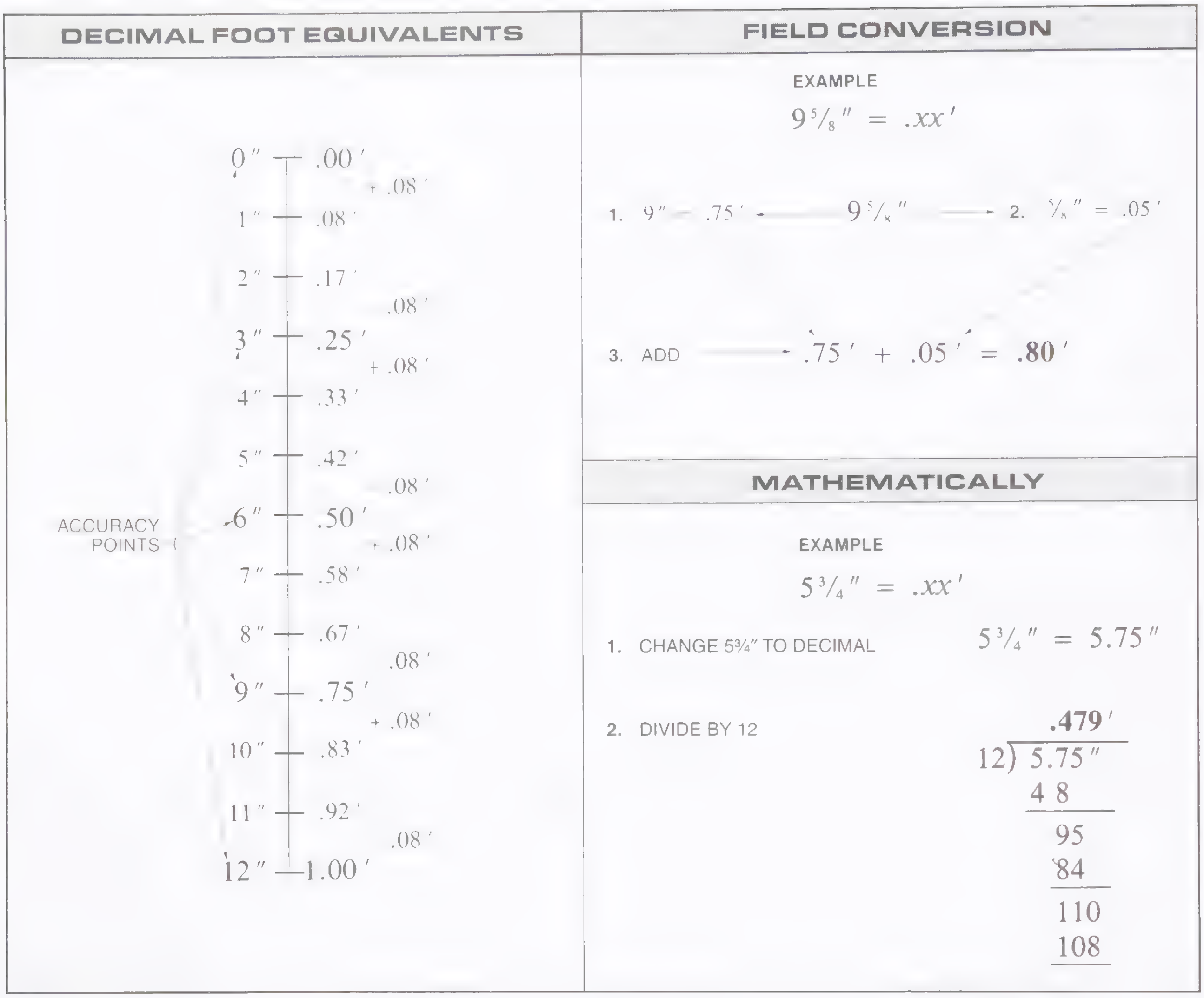


Figure 3-6. Inch-decimal conversion into decimal parts of a foot is accomplished mathematically or by field conversion.

Circular Measurement

Circumference, diameter, and radius are the components of circular measurement. See Figure 3-7. The circumference of a circle is the distance around its outside. The diameter of a circle is the distance of a straight line drawn from the edge of the circle through the centerpoint, to the edge on the opposite side of the circle. The radius is equal to one-half the diameter. For example, an object with a 4′-2″ diameter has a radius of 2′-1″.

Two dimensioning methods are used to define the sizes of circular objects, such as ductwork or piping, on residential prints. The first method, which is used for small objects, indicates the diameter of the item. The diameter symbol (ø) or the abbreviations "DIA" or "DIAM" are used to indicate diameter. The abbreviation "ID" indicates inside diameter and "OD" indicates outside diameter.

The second dimensioning method for circular objects is commonly used for larger items such as building arches or curves in streets. This method indicates the length of the radius of a curve from a given centerpoint. A leader line terminated with an arrow is drawn from the centerpoint and touches the circumference of the circular item. The length of the radius is noted along the leader line. The abbreviation "R" or "RAD" is used to indicate radius.

When calculating a circular area (A) using radius (r), pi (π) is multiplied by the radius squared ($A = \pi r^2$). The symbol π is equal to 3.1416. When calculating the area using diameter (d), .7854 is multiplied by the diameter squared ($A = .7854d^2$).

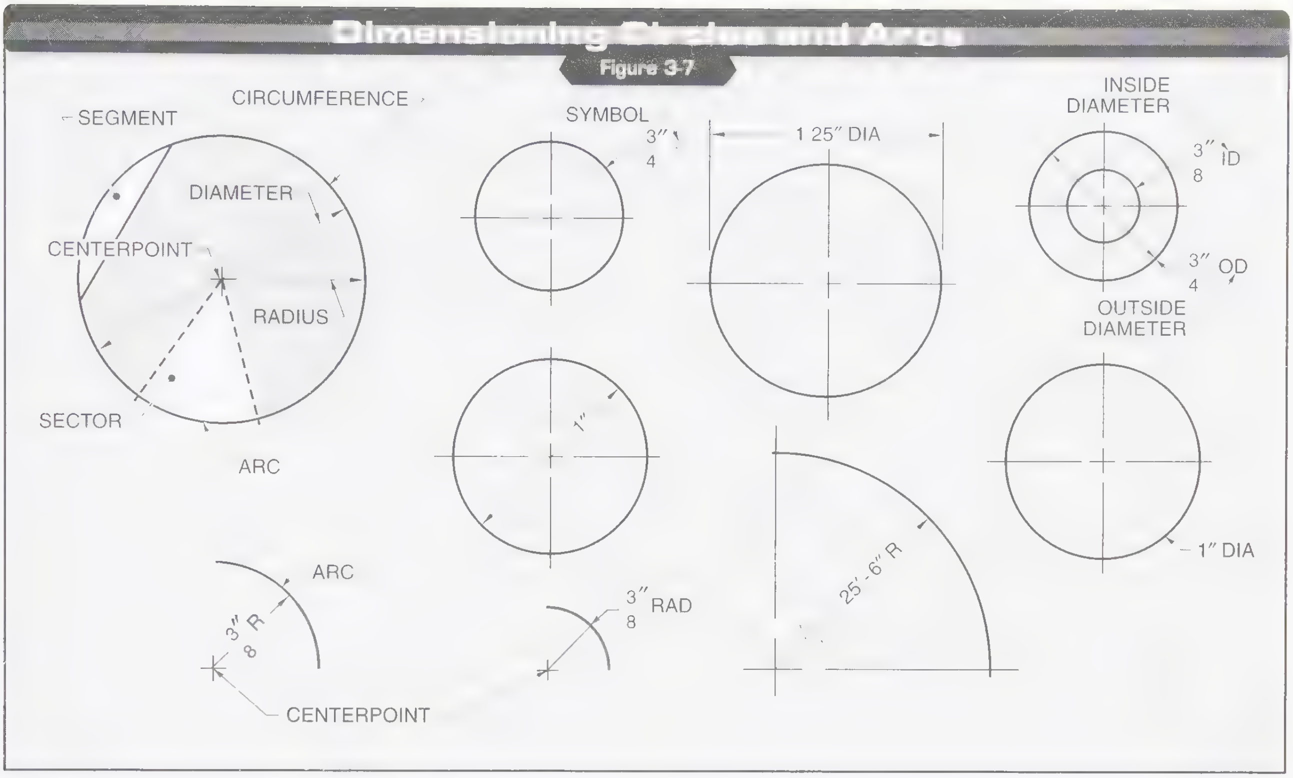


Figure 3-7. Circular objects are dimensioned using their diameter or radius.

Angular Measurement

Angles are based on subdivisions of a circle. In angular measurement, the circumference of a circle is divided into 360 equal sections. Each of these sections is equal to one degree. A degree is indicated on residential prints with the number of degrees followed by the degree symbol (°). For example, thirty-six degrees is shown as 36°. See Figure 3-8. Angular measurements are indicated on residential prints when laying out building and property lines.

A degree is further divided into 60 equal parts. Each one-sixtieth of a degree is equal to one minute. A minute is indicated on prints with the same symbol used to indicate foot dimensions (′). A minute measurement follows a degree measurement. For example, an angle of forty-five degrees and thirty-four minutes is expressed as 45°-34′.

Where greater accuracy is required, a minute is subdivided into 60 equal parts. Each division of a minute is equal to one second. Seconds are indicated on prints with the same symbol used to indicate inches (″). For example, an angle of fifty-four degrees, fifty-eight minutes, and thirteen seconds is expressed as 54°-58′-13″.

The 360° in a circle can be grouped into four equal quarters. Two diameter lines divide the circle into four quarters, or quadrants. Each quadrant contains 90°. Ninety-degree angles are created at the intersection of the quadrant boundary lines. A 90° angle is a square angle commonly referred to as a right angle. A straight line is a 180° angle.

A circular object such as a circular window contains 360°.

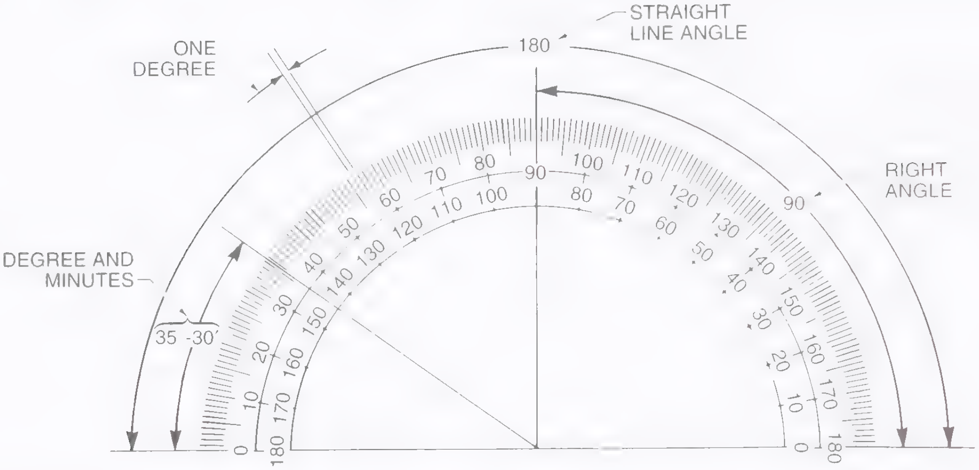
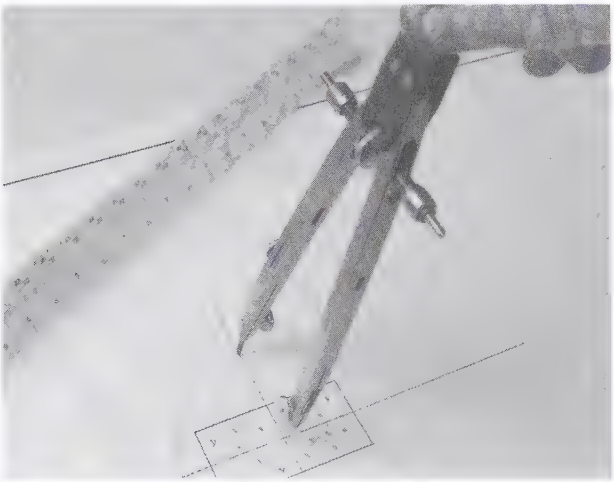


Figure 3-8. *Angles on residential prints are typically measured in degrees and minutes.*

SCALE

Most drawings on residential prints are created at a reduced size to properly fit the paper on which they are printed. Very small components shown on prints may be enlarged to show detail. The reduction or enlargement of drawings is referred to as drawing to scale. Scaling an object reduces or enlarges all parts of that object an equal amount to maintain a consistent size relationship between all the components. Trim and finish members may be drawn to actual size (full scale) to provide detail. The abbreviation "SC" used on prints indicates scale, the abbreviation "FS" indicates full scale, and the abbreviation "NTS" indicates not to scale.



An architect's scale, in conjunction with other drafting instruments, may be used to create scaled drawings.

Common Drawing Scales

Drawing scale is expressed as the fraction of an inch on a drawing that equals one foot of actual size. For example, ¼″ scale signifies that each ¼″ on the drawing equals 1′-0″ of actual size. Smaller drawing scales allow an architect to draw representations of large objects in a minimal amount of space. Drawings with larger drawing scales show more details. The drawing scale of a drawing is shown on the prints in a note from the architect. The ¼″ = 1′-0″ scale is the most common scale used for residential prints. Drawings created at different scales can appear on the same sheet. For example, details may be drawn to a larger scale, such as ½″ = 1′-0″, while the floor plan may be drawn to a smaller scale, such as ¼″ = 1′-0″.

Architect's Scale

An architect's scale is used to create scaled drawings and has three sides with an overall length of approximately 12½″. There are 10 common drawing scales on an architect's scale and one full scale. The 10 common drawing scales are ³⁄₃₂″ = 1′-0″, ⅛″ = 1′-0″, ³⁄₁₆″ = 1′-0″, ¼″ = 1′-0″, ⅜″ = 1′-0″, ½″ = 1′-0″, ¾″ = 1′-0″, 1″ = 1′-0″, 1½″ = 1′-0″, and 3″ = 1′-0″. See Figure 3-9. Each of the three sides on the architect's scale is divided into two halves. Each half of a side contains two drawing scales except for the half of the side with the full scale, which has only one scale. This arrangement provides four different drawing scales on two sides of the architect's scale, and three drawing scales on the remaining side.

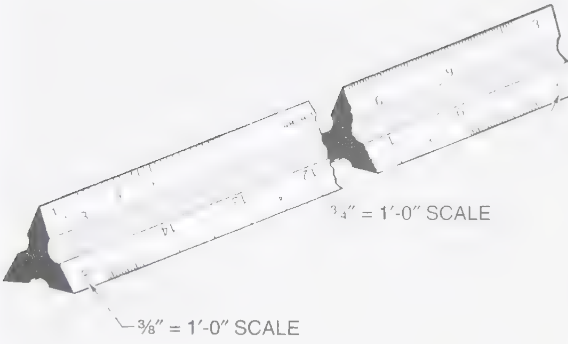


Figure 3-9. An architect's scale is used to scale objects on architectural prints.

Each half of a side combines two different drawing scales by using a larger and smaller scale. The smaller scale is one-half of the larger scale. For example, the ⅜″ = 1′-0″ scale and the ¾″ = 1′-0″ scale are on the same edge of the architect's scale. The two drawing scales are read in opposite directions. The drawing scale for each edge and direction of reading is noted by a fraction at the end of the scale. The "0" at the end of each scale is the starting point for scaling a line.

Foot values are shown on an architect's scale with long and short graduations (dividing lines) on each edge. Numbers at the end of dividing lines indicate the number of feet along the length of the scale.

Each end of an architect's scale beyond the "0" is divided into smaller segments to allow the scaling of inches. Larger scaling sizes allow for finer divisions of an inch. On the side with the 3″ = 1′-0″ scale, eighths of an inch are shown. On the side with the 3⁄32″ = 1′-0″ scale, the smallest inch division is 2″.

LINE TYPES

Many different line types are used on residential prints. Each type of line serves a specific function. The line type used depends on the location of the item shown and the dimensioning system. The basic line types are object lines, dimension lines, extension lines, leader lines, centerlines, hidden lines, cutting plane lines, section lines, and break lines. See Figure 3-10. In addition to the basic line types, other line types are used to show building lot contour and electrical and plumbing services. Line types and their use are standard among architects. The use of CAD software has further standardized the use of various line types.

Object Lines

Object lines show the outlines of building components. See Figure 3-11. Object lines are heavy solid lines without breaks. Foundation, floor, wall, and roof components are indicated with object lines.

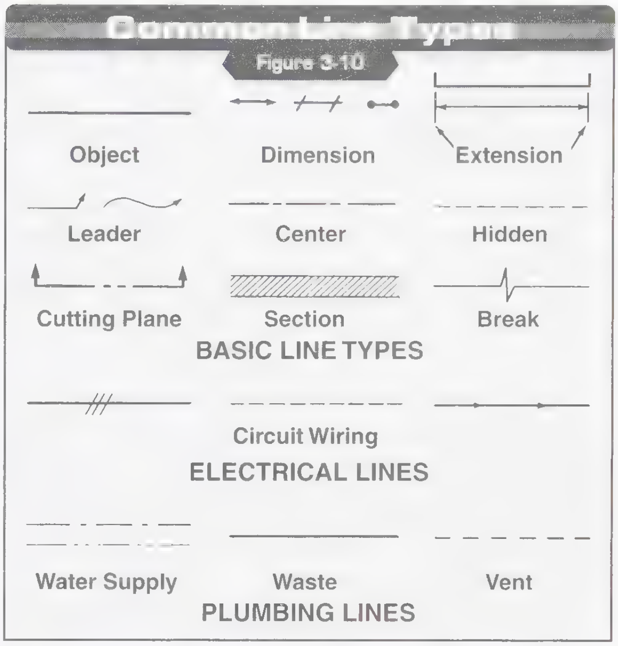


Figure 3-10. Common line types are used on all prints. Specialty lines, such as lines representing electrical cables and plumbing pipes, are used on specific prints.

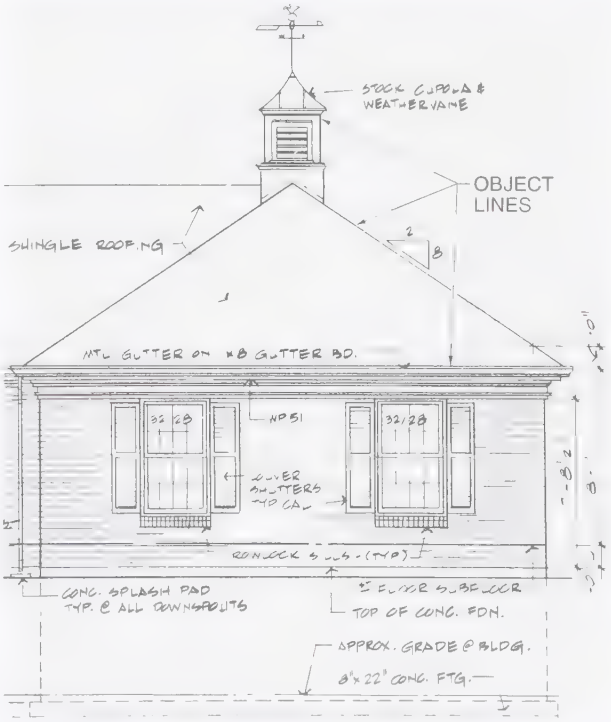


Figure 3-11. Object lines define the outline of a building.

Dimension Lines

A dimension line provides a place for the architect to show the necessary size information at a location on the drawing that is removed from the object itself. See Figure 3-12. While it is generally preferred that dimensions are not placed on the object, they may be placed on the object if the need arises. The dimension line is a thin, solid line. Dimension lines may be continuous or have a break large enough for the insertion of dimensions. Dimension lines are parallel to the object they define and are terminated with an arrow, slash, or dot at each end.

Angles are shown on residential prints using a curved dimension line with an arrowhead at each end. Curved dimension lines may be solid or have a break large enough for placement of degree, minute, and second notations.

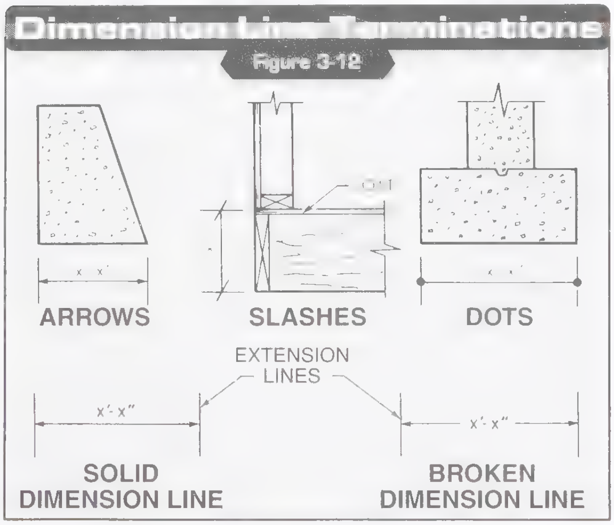


Figure 3-12. Dimension lines are drawn parallel to the feature being dimensioned. Dimension lines are terminated at extension lines.

Extension Lines

Extension lines extend from object lines and provide a termination point for dimension lines. Extension lines are thin lines that are drawn at 90° to object and dimension lines. Extension lines are shown on drawings at corners, edges, and intersections of building components. Extension lines do not touch the object line; a small gap is maintained between the object and the extension lines. Arrows, slashes, or dots on the ends of dimension lines touch extension lines. Extension lines extend approximately ⅛″ beyond the dimension lines. A single extension line may be used as a termination point for several dimension lines.

Leaders

Some building components shown on prints require written descriptions (notations) from the architect. A leader extends at any angle from the notation to the part being described. Leaders are terminated with arrows at the end where they contact the part.

Centerlines

Centerlines indicate the center of an object using thin, dark lines broken by short dashes See Figure 3-13. Centerlines are indicated with the abbreviation "CL" or the centerline symbol (℄). Centerlines are used as extension lines to indicate the location of objects such as piers, windows, and doors.

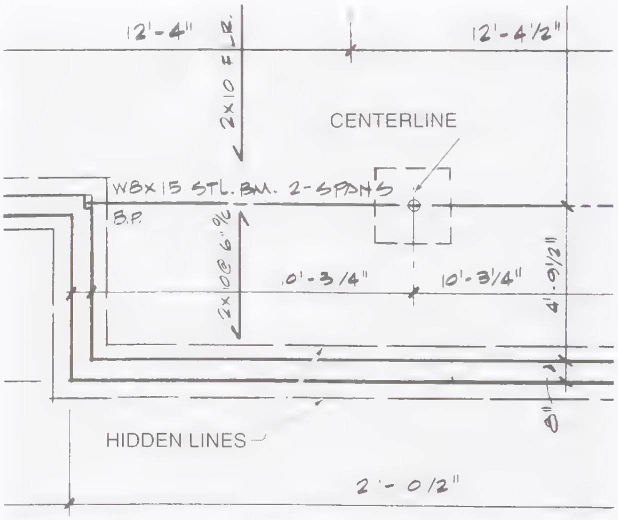


Figure 3-13. Centerlines locate the centers of objects. Hidden lines show objects that are not visible in a drawing.

Hidden Lines

Not all objects on a print can be shown with object lines. Some objects are hidden on the various views and sections. Hidden lines are heavy dashed lines. For example, foundations and footings are typically shown on drawings with hidden lines.

Cutting Plane Lines

Where detailed information is required and components cannot be shown from the exterior, an architect will "slice" through a component to show interior features. The location of the "slice" is indicated with a cutting plane line. A cutting plane line is a thick line with an arrow on each end that is at a 90° angle to the line. Cutting

plane lines may be continuous or broken, although they are generally broken by two short dashes. Cutting plane lines pass through the item to be detailed. The direction the arrows point at the ends of the cutting plane line indicates the direction in which the section is viewed.

A letter or number is included near the arrow at each end of the cutting plane line. The letter or number indicates the letter or number designation given to each section or detail. The letter or number may indicate the sheet on which the section or detail is shown, especially when the section or detail is shown on another sheet of the prints.

Section Lines

Section lines indicate the types of materials shown in a section through which a cutting plane has been passed. See Figure 3-14. Section lines are drawn at an angle (typically 30°, 45°, or 60°) to object lines.

A variety of section lines with different spacing between the lines are used to clearly and uniquely distinguish materials from one another. For example, building brick is shown in sections with equally spaced diagonal lines, steel is shown in sections with double diagonal lines, and rubber, plastic, and electrical insulation is shown in sections with triple diagonal lines. Brass, bronze, and copper are shown with alternating solid and dashed diagonal lines. When different types of material are adjacent to each other on drawings, the section lines for each material are drawn at different angles.

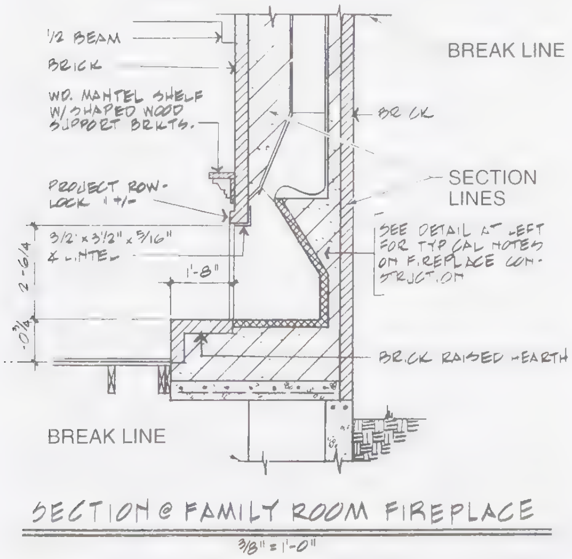


Figure 3-14. The interior features of an object are shown with a cutting plane passed through the object.

Break Lines

Break lines reduce the amount of drawing space required to show long objects. Break lines are also used to neatly discontinue a drawing where no further length of an object needs to be shown. Break lines may be straight lines with a "Z" in the middle or freehand, staggered lines. Long items that require drawings of each end may be shortened with a pair of break lines in the middle of the drawing to avoid taking up space with a continuous-length item that does not need further description.

Specialty Lines

Dashed lines and lines with slashes and other markings indicate the slope of a building lot and locations for electrical cables, plumbing pipes, and other utilities. See Figure 3-15. Architects provide descriptions of other specialty lines when they are required to depict items on drawings.

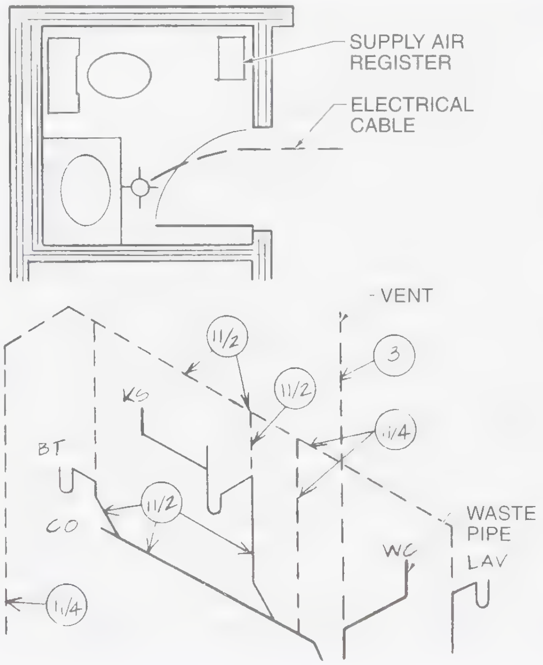


Figure 3-15. Electrical cables, plumbing pipes, and other utilities are shown with specialty lines.

Contour Lines. Contour lines are dashed or solid lines that show the slope of a building lot. See Figure 3-16. Dashed contour lines indicate the existing slope of a building lot. Solid contour lines show the planned grading of a lot. Each contour line is accompanied by a dimension indicating the elevation in relation to sea level or a datum. The dimension is typically expressed in feet and decimal parts of a foot. Depending on the nature

of the building lot, contour lines are straight or curved. Contour lines spaced more closely together indicate a steep slope. Contour lines spaced farther apart indicate a gradual slope.

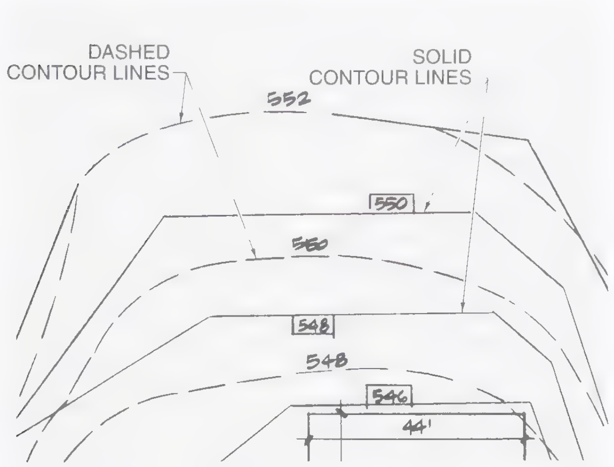


Figure 3-16. Contour lines and associated dimensions indicate the existing and planned slope of a building lot.

Electrical. Electrical cables are represented by either dashed or solid lines and may have slash marks along their length. Lines for electrical work show the configuration of circuitry and switches. Each circuit is numbered. One line can be followed through a circuit from the service panel to fixtures to switches. Slash marks through electrical cables indicate the number of conductors in the circuit. A notation on the drawings along the electrical cable may also provide this information and the type of sheathing on the electrical cable.

The end of an electrical cable line may terminate with an arrow indicating its run to the panelboard. Lines representing electrical cables do not indicate the exact location for placement of cable in the residence. Rather, the cables are installed according to the circuits shown at locations convenient to the electrician and in accordance with the National Electrical Code® and any local electrical code requirements.

Plumbing. Lines representing plumbing pipes indicate water supply pipes, waste pipes, and vents. Water supply pipes are shown with alternating long and short dashed lines. Waste pipes are shown with object lines. Vent pipes are shown with hidden lines. The sizes of plumbing pipe to be installed are shown on residential prints along plumbing lines with notations from the architect indicating pipe diameter.

Heating, Ventilating, and Air Conditioning. Solid object lines are used where necessary to show ductwork on residential prints. Small arrows may also be shown on prints for forced air systems to indicate locations for air supplies and air returns.

REVIEW QUESTIONS

3

Dimensioning

Name ______________________________ Date ______________

True-False

T	F	1. Most residential plans are drawn to full scale.
T	F	2. The numerator is the number above the fraction bar.
T	F	3. Field conversion is more accurate than the mathematical method of changing inches into decimal foot equivalents.
T	F	4. The smallest drawing scale on the architect's scale is 1″ = 1′-0″.
T	F	5. Object lines are dashed lines.
T	F	6. Dimension lines are 90° to the object they describe.
T	F	7. Leaders extend between architectural notations and objects.
T	F	8. Contour line dimensions are shown in feet and inches.
T	F	9. Measurements to the nearest tenth of a foot are more accurate than measurements to the nearest hundredth of a foot.
T	F	10. Fraction denominators of 6, 12, and 20 are common on residential prints.
T	F	11. Hidden lines and plumbing vent lines are shown with the same line type.

Multiple Choice

______________ 1. The largest unit of measurement on residential prints is ___.

A. inches
B. feet
C. yards
D. furlongs

______________ 2. Measurements on an architect's scale are read from ___.

A. right to left
B. left to right
C. both directions
D. none of the above

___ **3.** One-hundredth of an inch is expressed as ___.

A. .1
B. .01
C. .001
D. none of the above

___ **4.** The fraction ⅜″ is equal to ___″.

A. .125
B. .25
C. .375
D. .45

___ **5.** A circle contains ___°.

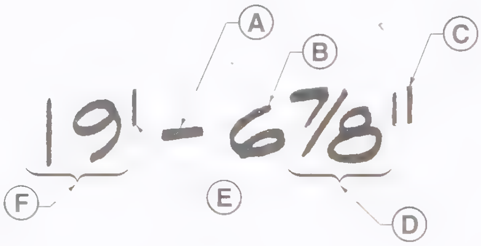
A. 45
B. 90
C. 180
D. 360

___ **6.** Slash marks on an electrical line indicate the ___.

A. circuit number
B. number of switches
C. number of conductors in the circuit
D. location of panelboard

Identification

Identify the following components of a dimension.



___ **1.** Inches

___ **2.** Feet

___ **3.** Inch mark

___ **4.** Foot mark

___ **5.** Fraction

___ **6.** Dash

Completion

For questions 1 to 5, write the dimensions as they are shown on residential prints.

___ **1.** Six and three-quarter inches.

___ **2.** Five feet, nine and seven-eighths inches.

___ **3.** Ten feet and one-half inch.

___ **4.** Fifty-two feet and sixty-four-hundredths of a foot.

___ **5.** Thirteen-sixteenths of an inch.

___ **6.** Addition and subtraction of fractions require a common ___.

7. The decimal inch equivalent of 9⁄16″ is ___″.

8. 3⅝″ + 9½″ = ___.

9. The foot decimal equivalent of 5⅛″ is ___′.

10. For field conversions, there are ___ accuracy points.

11. The abbreviation “SC” indicates ___.

12. Full scale is abbreviated as ___.

13. “CL” is the abbreviation for ___.

14. 15′-3″ + 12′-10″ = ___.

15. 16′-4″ – 10′-9″ = ___.

16. 3′-2″ × 10 = ___.

17. 4′-10″ divided by 6 = ___.

18. There are ___ degrees in a quadrant.

19. The angle of forty degrees, thirteen minutes, is shown on residential prints as ___.

Matching

___	1. ø	A. diameter symbol
___	2. OD	B. diameter
___	3. ID	C. inside diameter
___	4. DIA	D. radius
___	5. R	E. outside diameter

Measurement

In the space provided, write the dimension on the architect's scale as indicated using the given scales.

12′-3″ **Example:** ¼″ = 1′-0″

______ **1.** ¼″ = 1′-0″

______ **2.** ¼″ = 1′-0″

______ **3.** ¼″ = 1′-0″

______ **4.** ⅜″ = 1′-0″

______ **5.** ¾″ = 1′-0″

______ **6.** ½″ = 1′-0″

______ **7.** 1″ = 1′-0″

______ **8.** 1½″ = 1′-0″

______ **9.** 1½″ = 1′-0″

______ **10.** 3″ = 1′-0″

Activities

1. Using an architect's scale, draw lines to the following lengths at the scale indicated.

	Scale	Length
A.	¼″ = 1′-0″	15′-9″
B.	3/32″ = 1′-0″	42′-3″
C.	½″ = 1′-0″	6′-5½″
D.	¼″ = 1′-0″	16′-3¾″
E.	⅛″ = 1′-0″	30′-3″

2. On a set of residential prints, identify all line types, including specialty lines.

3. Using a tape measure, measure a room and the objects in it to practice accurate measuring and dimension reading.

Identification

Identify the lines shown on the following print.

_______________ **1.** Dimension line

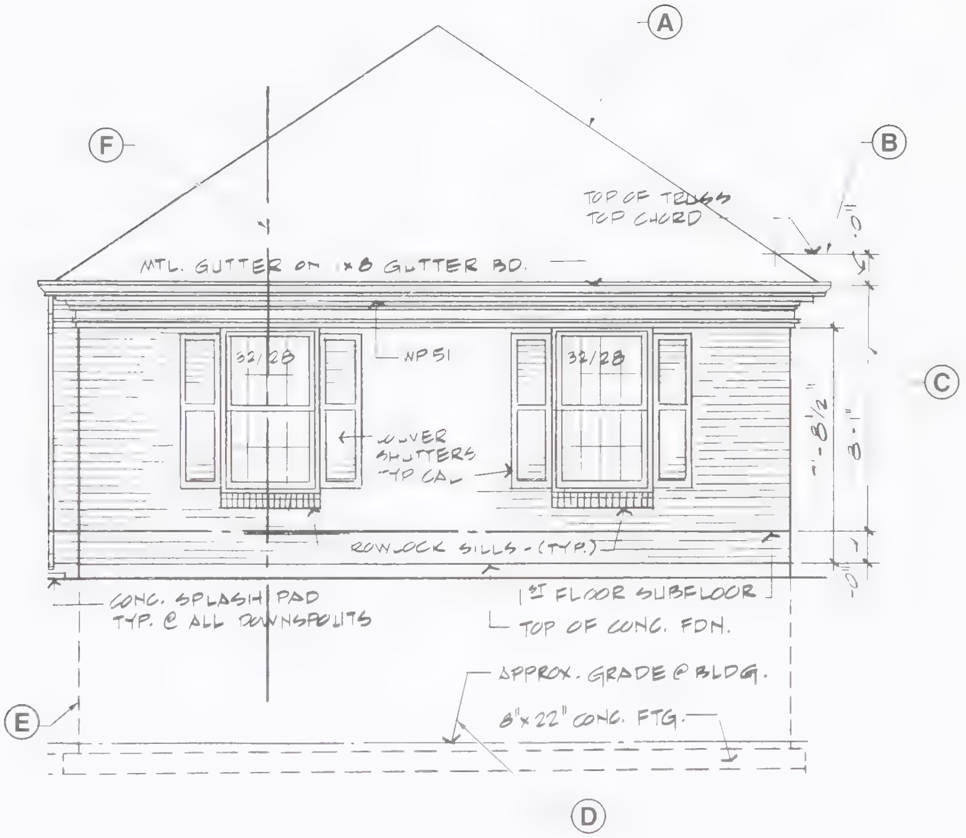
_______________ **2.** Object line

_______________ **3.** Hidden line

_______________ **4.** Centerline

_______________ **5.** Extension line

_______________ **6.** Leader



CHAPTER 4

Drawing Representation Methods

> ***A**rchitects create many different types of drawings to provide the construction information required to build a house. Different drawing representations allow the owner and tradesworkers to visualize the house and its components during design and before construction begins.*
>
> *Four basic types of drawings are used to show a house and its components. Perspective, oblique, and isometric drawings are pictorial drawings that provide a three-dimensional representation of a house. While pictorial drawings are useful to a potential owner in visualizing the house to be constructed, they are rarely included in a set of residential prints. Orthographic projections, such as elevations and plan views, provide more information for a tradesworker constructing the house.*

TYPES OF DRAWINGS

Four basic types of drawings are used to show a house and its components—perspective, oblique, isometric, and orthographic. See Figure 4-1. Each type of drawing conveys building information in a way that cannot be shown on other drawings.

Perspective Drawings

A perspective drawing is a pictorial drawing that is similar to a photograph. See Figure 4-2. A perspective drawing shows a house as it actually appears to a person viewing the house.

The actual sizes of items are not constant on a perspective drawing. The size of the same item changes relative to its distance from the viewer. Items close to the viewer are drawn larger while items farther away from the viewer are drawn smaller to create a three-dimensional appearance. The human eye compensates for the size changes so that items appear to be in proportion relative to each other.

Receding object lines on a perspective drawing are angled toward vanishing points. Perspective drawings may give the impression of looking at an object from above, ground level, eye level, or any other angle of view desired.

Perspective drawings are created using one, two, or three vanishing points. One-point perspective drawings, also referred to as parallel perspectives, show one face of an object at actual size with parallel vertical and horizontal lines. Receding depth lines provide the three-dimensional appearance. Two-point perspective drawings are the most common type of perspective drawing. As the name suggests, two-point perspective drawings have two vanishing points, with receding horizontal lines angled toward the vanishing points. Three-point perspective drawings create the image of viewing an object from above or below, depending on the position of the third vanishing point. For example, a three-point perspective drawing may be used to show a tall building as it appears from street level.

The Garlinghouse Company

Perspective drawings are similar to photographs.

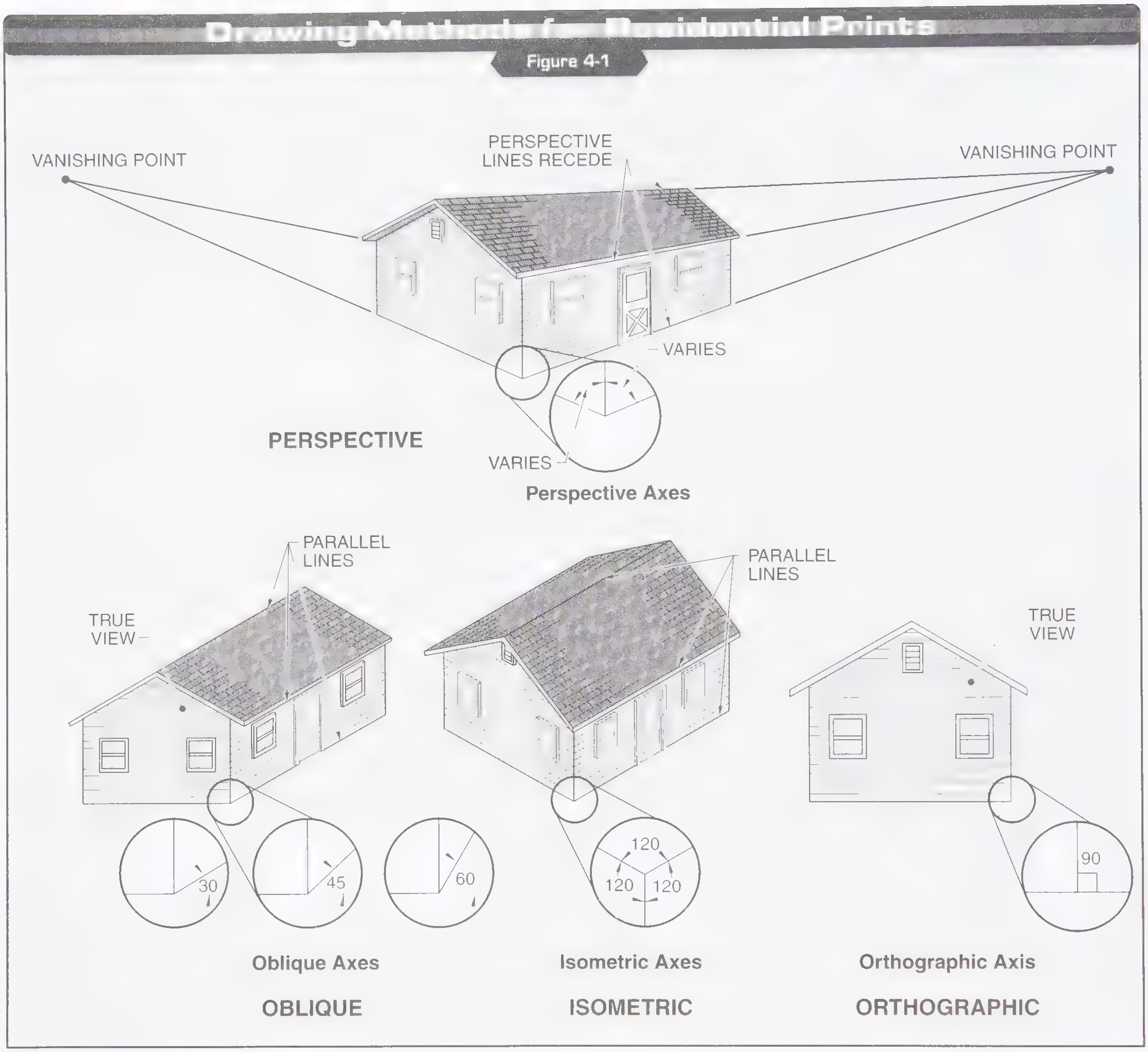


Figure 4-1. *Perspective, oblique, and isometric drawings and orthographic projections are used to show a house.*

Perspective drawings are created by architects to help the potential owner visualize the finished appearance of the house. They are commonly included in the real estate section of a newspaper as advertisements. Perspective drawings contain no structural information for tradesworkers and are not typically included in a set of residential prints.

Perspective drawings are a type of presentation drawing typically used to present design ideas to potential homeowners.

Oblique Drawings

An oblique drawing is also a pictorial drawing. Oblique drawings are not as attractive as perspective drawings but give the viewer the impression of three-dimensional objects.

An oblique drawing projects one surface of an object onto a flat plane. Items on the flat plane are shown at true dimensions with no adjustments made for distance or perspective. To provide the appearance of a three-dimensional object, parallel lines are drawn from the corners and edges of the flat plane at any angle other than 90°. The parallel lines are called oblique lines. The most common angles for oblique lines are 30°, 45°, and 60° from a horizontal baseline.

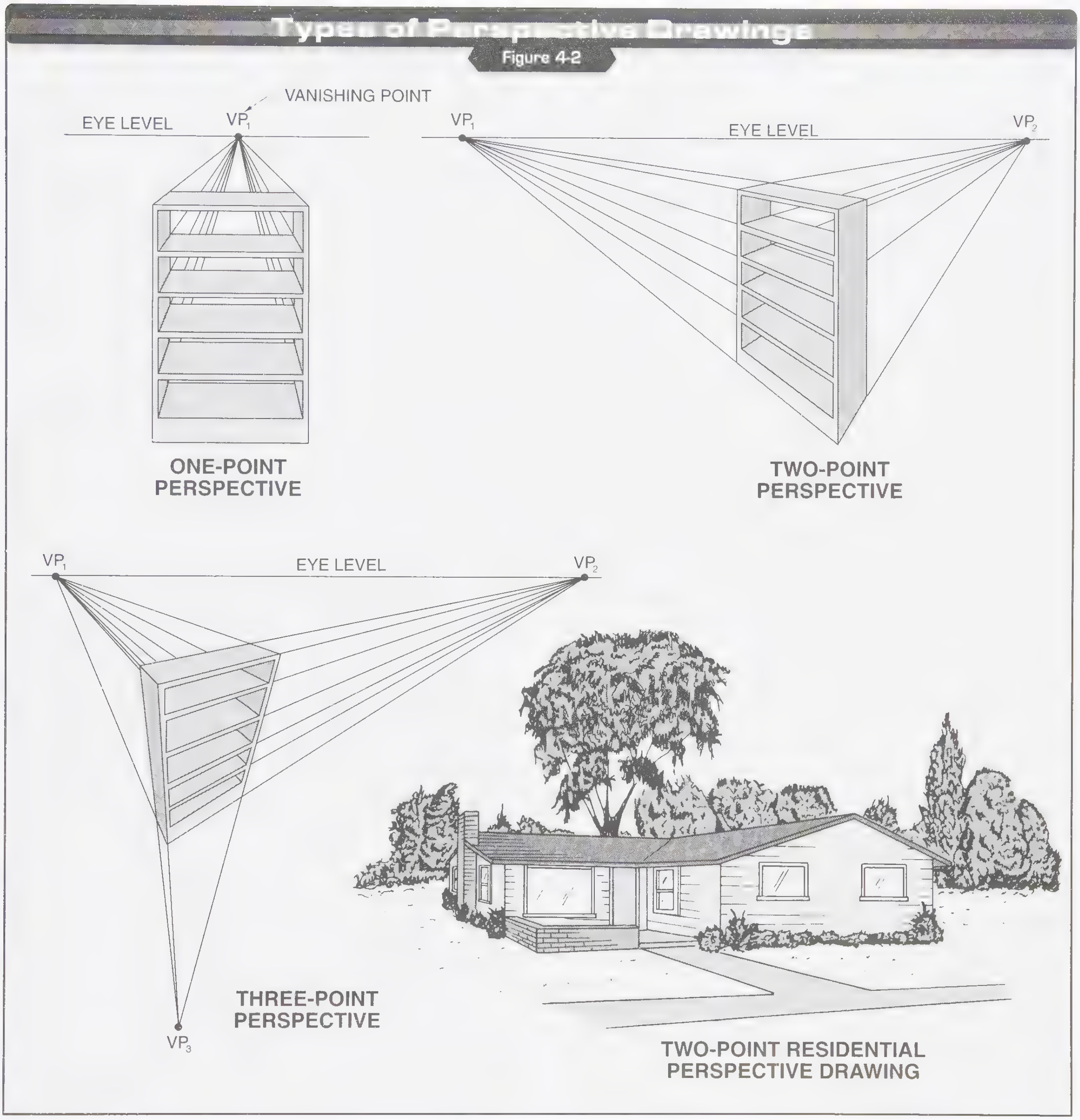


Figure 4-2. *A perspective drawing shows an object as it appears to the human eye but provides no actual building information. Lines receding to vanishing points create the three-dimensional appearance.*

Two types of oblique drawings are cavalier drawings and cabinet drawings. See Figure 4-3. On cavalier drawings, lines for the face of the object and the oblique lines are all drawn at the same scale. This technique allows any portion of the drawing to be scaled accurately. Dimensions can be provided for height, width, and depth. On cabinet drawings, oblique lines are drawn at one-half the scale of the object lines that show the face of the object. Cabinet drawings have a more realistic appearance than cavalier drawings. Oblique drawings are used occasionally on residential prints to detail cabinetry, moldings, and other small items.

Receding lines in oblique drawings are drawn at 30°, 45°, or 60° angles.

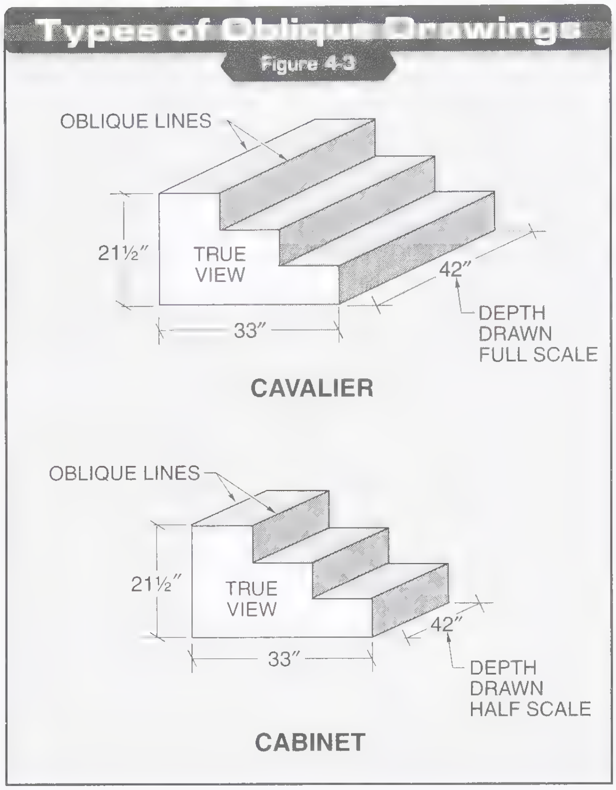


Figure 4-3. *Oblique drawings show a true view of one face of an object. Oblique cabinet drawings are more common than oblique cavalier drawings.*

Isometric Drawings

An isometric drawing is another type of pictorial drawing that shows three sides of an object. Isometric drawings are based on three axes and a baseline. See Figure 4-4. The baseline is a horizontal reference line and is not part of the finished drawing. The baseline is only used to develop the relationship of the three axes.

The first axis is perpendicular (at 90°) to the baseline, forming an inverted T. The remaining two axes are drawn 30° from the baseline. The 30° axes originate from the point where the perpendicular axis intersects the baseline. Items are shown with lines drawn parallel to one of these three axes. Each of the three axes are 120° from each other.

Lines along the three axes are drawn to the same scale. This technique provides the impression of three dimensions and maintains a consistent size relationship between each face. Dimensions can be applied to each side of an isometric drawing if desired. No true view is shown of any surface.

Angular faces and edges of an object that are not square with the other edges are shown with lines that are not parallel to the three axes. The lengths of angular lines on an isometric drawing are not to scale. The angular face or edge is drawn by scaling the length of lines that are parallel to the axes and establishing reference points. Lines that connect these points form the angular face. Angular lines are shorter or longer than the actual scale dimension, depending on the side of the vertical axis on which they are located.

Circles on an isometric drawing are also not to scale because of the 30° axes. A circle or radius is drawn from known dimension points along object lines parallel with one of the three axes. Curves are sketched between the points and the circles are dimensioned using standard diameter and radius symbols.

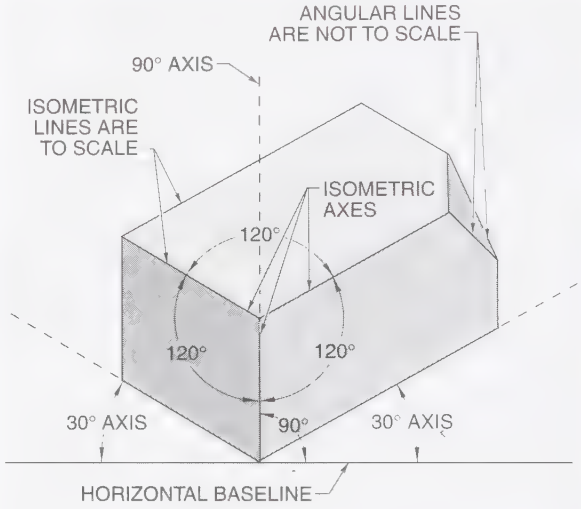


Figure 4-4. *Axes on isometric drawings are 120° apart.*

Orthographic Projections

The most common drawing representation method used on residential prints is orthographic projection. An orthographic projection, also known as a multiview drawing, is created by projecting one face of an object onto a flat surface. See Figure 4-5. Only one face or side of an object is shown. Items appear on a flat plane, at a true relationship to each other. Each view of an orthographic projection is drawn at the same scale.

Elevations. The front, back, and sides of a house are shown with an orthographic projection created by looking horizontally at each face of the house. See Figure 4-6. Orthographic projections of the exterior of a house are referred to as exterior elevations. Elevations typically provide dimensions and construction material information about the exterior face of a house. The faces of interior walls are shown with interior elevations.

The term "orthographic projection" refers to the fact that a graphic image is projected onto a flat plane perpendicular (orthogonal) to the plane.

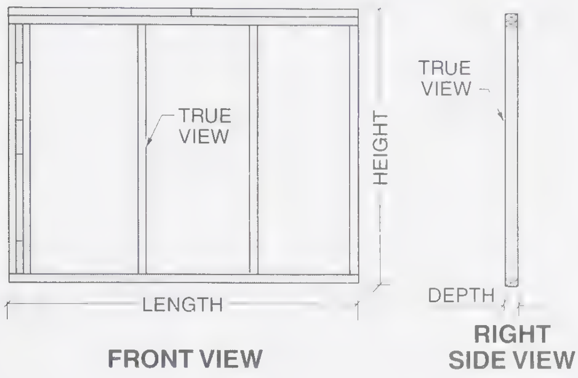


Figure 4-5. *Orthographic projections show each surface of an object as if projected onto a flat plane. Generally, at least two views are needed to fully describe a three-dimensional object.*

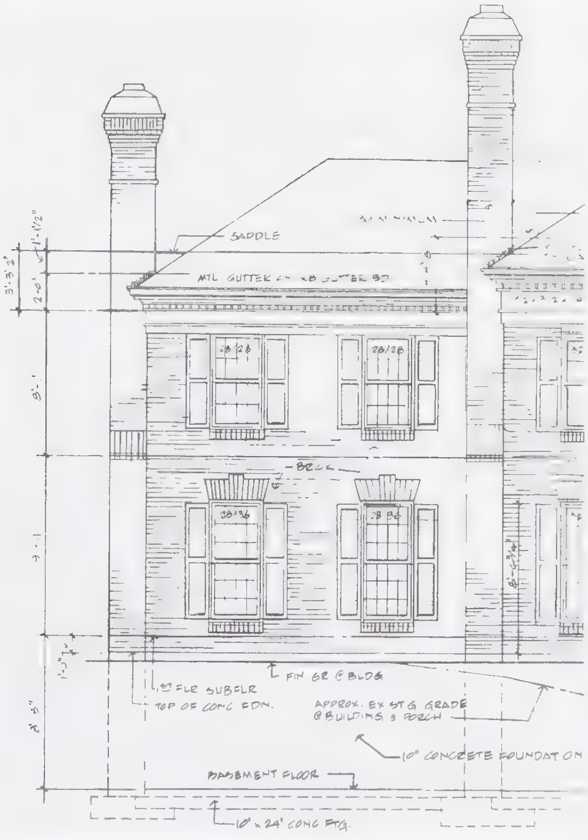


Figure 4-6. *Elevations are orthographic projections.*

An exterior elevation provides information about construction materials used on the exterior face of a house.

CUTTING PLANES

Room layouts, construction materials, and construction dimensions are shown on residential prints with drawings that are created by taking an imaginary slice through an entire house or portion of a house. The slices produce cutting planes at different locations throughout the house. Cutting planes are typically taken in a straight line, but they may also be taken in a broken pattern. Objects encountered on the cutting plane are projected onto a flat surface, as with an orthographic projection. Cutting planes taken horizontally or vertically to show details are called plan views, sections, and details. See Figure 4-7.

Plan Views

Cutting planes are taken horizontally through a house to show many building items including partitions, room arrangements, and fixtures. The horizontal cutting plane for a plan view is located approximately 5′-0″ above the floor of the structure. Plan views are viewed as if the print reader is looking down on the house from above.

A plan view cutting plane slices through walls, cabinets, and all other items it encounters. Plan views are created by projecting the cutting plane onto a flat surface. All items at and below the 5′-0″ level are shown using object lines. Items above the 5′-0″ level may be shown with hidden lines and described by the architect if necessary. Items hidden from view and objects below the floor level of the cutting plane can also be shown with hidden lines. The foundation, wall locations, and dimensions are shown on plan views with cutting planes. Roof plans, which may detail rafters and ceiling joists, are plan views with information about materials and dimensions.

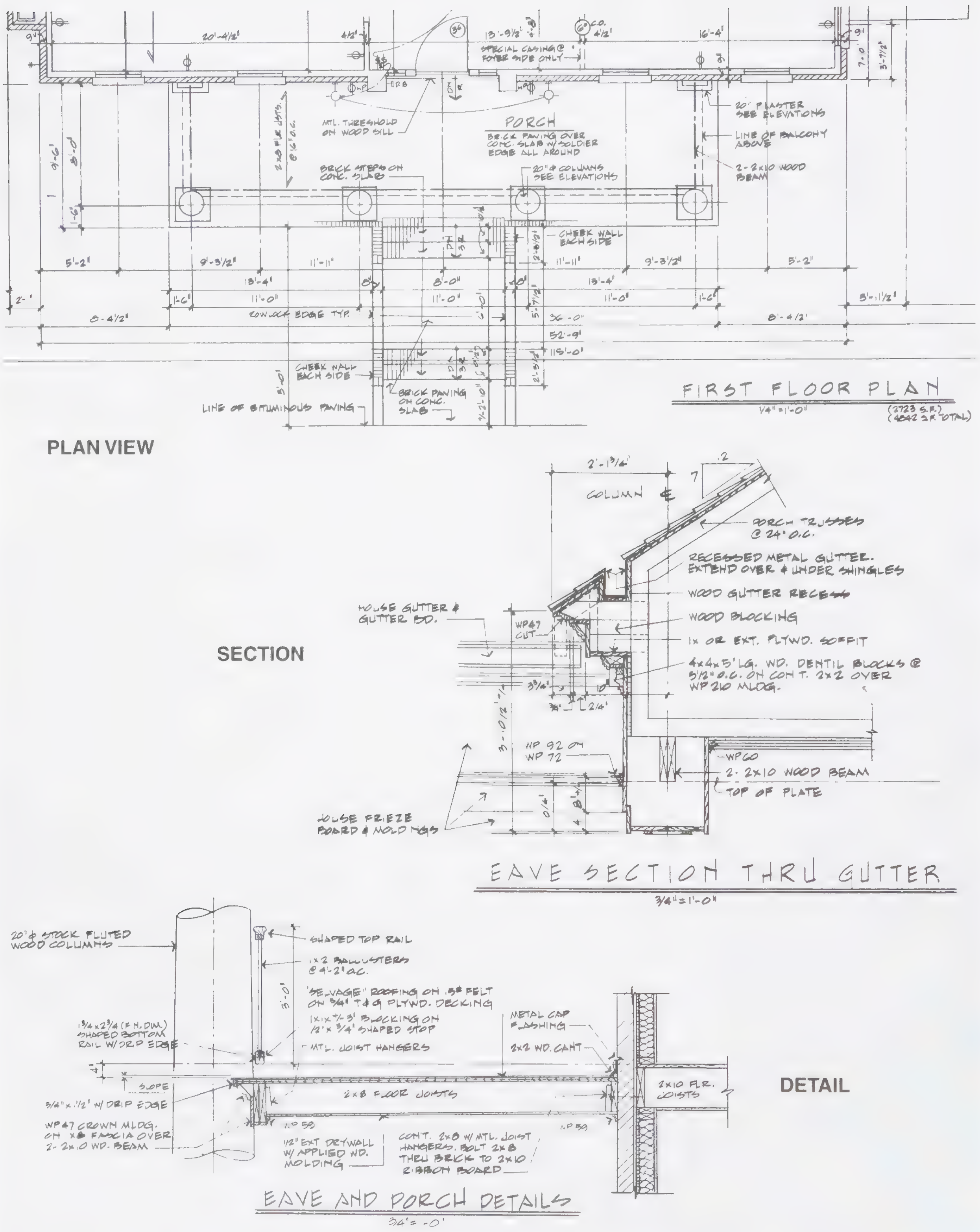


Figure 4-7. *Cutting planes are used to create plan views, sections, and details.*

Sections

Vertical or horizontal cutting planes made through a wall or other building structure are sections. Sections provide details about specific parts of a house and the components used for their construction. Sections are created using orthographic projections and show dimensions, materials, design, and structure. For example, wall sections show the dimensions and locations of plates, studs, masonry, concrete, exterior finish, and interior wall coverings. The cutting planes used to create the sections are identified using letters or numbers.

Details

Details provide information about moldings, fixtures, and other specialty items that require a more detailed description than can be provided on other views. Cutting planes may be taken for details to show the interior of building items.

Details can also be created to show a profile or exterior view of an item without a cutting plane. Construction materials are noted and dimensions are provided on details. Details can be orthographic projections or oblique drawings and can be created at full scale to show small details.

American Hardwood Export Council

Details provide information about items, such as moldings and fixtures, that require additional description.

Details are plan views or sections drawn at a larger scale than other drawings in a set of prints.

ABBREVIATIONS AND SYMBOLS

Space limitations on residential prints require that architects use several methods to shorten the descriptions of materials. All of the information needed to construct a house may not fit on a manageable sheet size. Including full descriptions of each building component would make prints very difficult to read due to the clutter of information. Abbreviations representing common construction terms and symbols that depict common building components allow more information to be placed on the drawings without cluttering the prints and occupying excess drawing space.

Abbreviations

Abbreviations are one or several letters in length. **See** Figure 4-8. Abbreviations may appear in sets of two or more groups of letters. For example, "STL COL" is the abbreviation for steel column. Abbreviations are used together with unabbreviated written information to fully describe an item or component. An abbreviation that spells out a standard term is typically followed by a period. Although standard abbreviations have been developed for many terms, abbreviations may vary depending on the architect's preference.

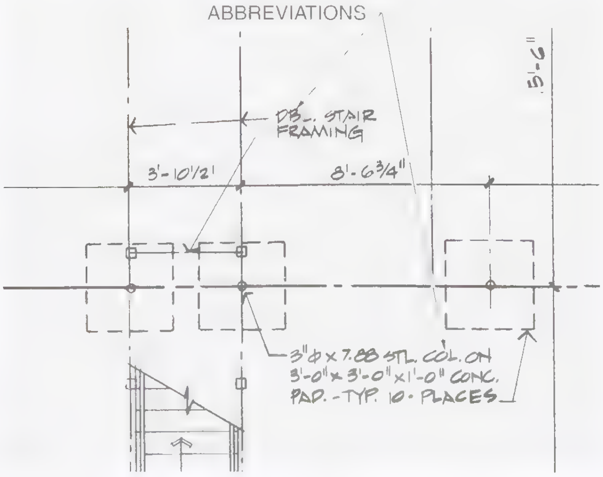


Figure 4-8. Abbreviations conserve space on prints.

Some terms may share a common abbreviation. Although some terms use the same standard abbreviation, an interpretation based on the context in which they are used clarifies their specific use. For example, the abbreviation "KD" means kiln-dried when referring to lumber and knocked-down when referring to door frames. Abbreviation meanings can also change depending on the type of drawing on which the abbreviation appears. Therefore, an abbreviation on a floor plan may not have the same meaning as an abbreviation on an elevation.

Only uppercase (capital) letters are used for abbreviations on drawings.

Symbols

A symbol is a pictorial representation of a structural or material component used on a print. See Figure 4-9. Symbols are used on all types of drawings included in a set of residential prints. An architect may provide a legend on a drawing to help the print reader interpret the symbols.

Symbol meanings can change depending on the type of drawing on which the symbols appear and their location on the drawing. A construction material may be shown with one symbol on a section and with a different symbol on a floor plan.

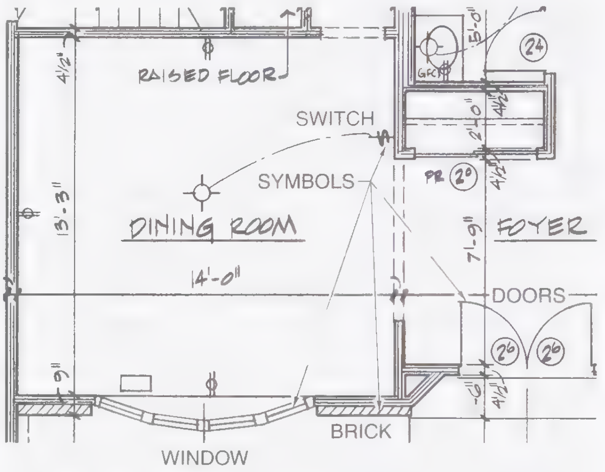


Figure 4-9. *Symbols are pictorial representations of structural or material components.*

REVIEW QUESTIONS

4

Drawing Representation Methods

Name ______________________________ Date ______________

True-False

T F **1.** A perspective drawing is similar to a photograph of an object.

T F **2.** Perspective drawings are commonly included in sets of residential prints.

T F **3.** Oblique drawings project parallel lines from the face of an object to produce a three-dimensional effect.

T F **4.** Lines along the three axes of an isometric drawing are drawn to the same scale.

T F **5.** The lengths of angular lines in isometric drawings are drawn to scale.

T F **6.** Sections are created using perspective drawing techniques.

T F **7.** Abbreviations cannot be more than two letters in length.

T F **8.** Symbols are pictorial representations of structural or material components.

Multiple Choice

______________ **1.** A(n) ___ drawing contains no structural information for tradesworkers.
- A. perspective
- B. oblique
- C. isometric
- D. none of the above

______________ **2.** ___ are horizontal orthographic projections of the exterior of a house.
- A. Isometric drawings
- B. Elevations
- C. Plan views
- D. Oblique drawings

______________ **3.** In a perspective drawing, objects closer to the viewer are drawn ___ objects farther away.
- A. smaller than
- B. larger than
- C. the same size as
- D. none of the above

_______________ **4.** ___ are not three-dimensional.
- A. Perspective drawings
- B. Oblique drawings
- C. Isometric drawings
- D. Orthographic projections

_______________ **5.** Oblique lines are drawn ___.
- A. parallel
- B. at 30° to the baseline
- C. at 90° to the baseline
- D. the same way as hidden lines

_______________ **6.** On cabinet drawings, oblique lines are drawn at ___ the scale of the object lines that show the face of the object.
- A. one-fourth
- B. one-third
- C. one-half
- D. none of the above

_______________ **7.** The most common angle for oblique lines is ___°.
- A. 30
- B. 45
- C. 60
- D. all of the above

_______________ **8.** Abbreviations ___.
- A. are capitalized
- B. can be shared by two or more terms
- C. conserve space on prints
- D. all of the above

_______________ **9.** Symbols describe ___.
- A. dimensions
- B. locations
- C. construction materials
- D. drawing types

Completion

_______________ **1.** Oblique drawings show ___ side(s) of an object.

_______________ **2.** Two of the axes for isometric drawings are drawn at ___° to the baseline.

_______________ **3.** The horizontal cutting plane for plan views is located approximately ___ above the floor line.

_______________ **4.** Items above a plan view cutting plane are drawn with ___ lines.

_______________ **5.** Two types of oblique drawings are ___ and ___.

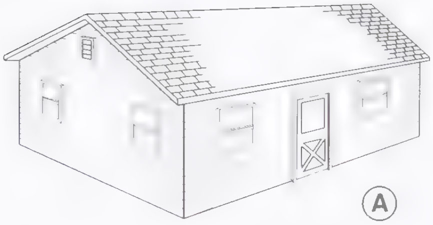
Identification

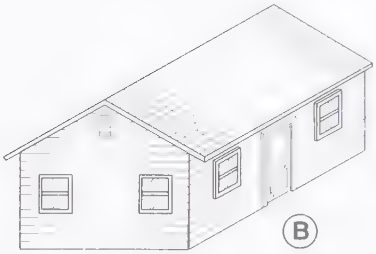
_______________ **1.** Orthographic projection

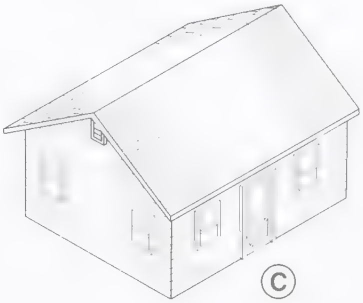
_______________ **2.** Oblique drawing

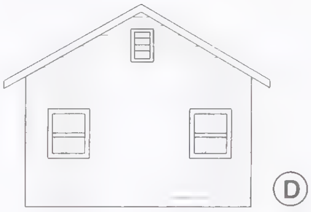
_______________ **3.** Isometric drawing

_______________ **4.** Perspective drawing







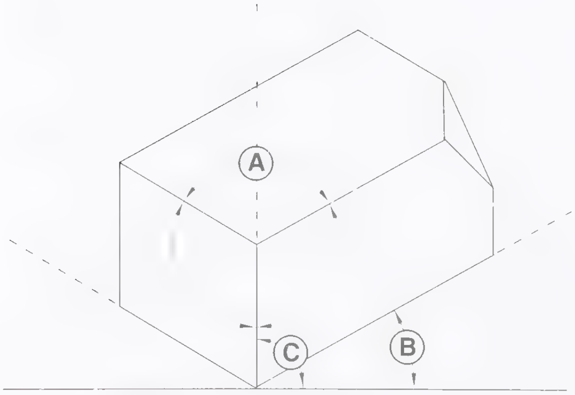


Identify the angles of an isometric drawing.

_______________ **5.** 30°

_______________ **6.** 120°

_______________ **7.** 90°



Identify the types of drawings.

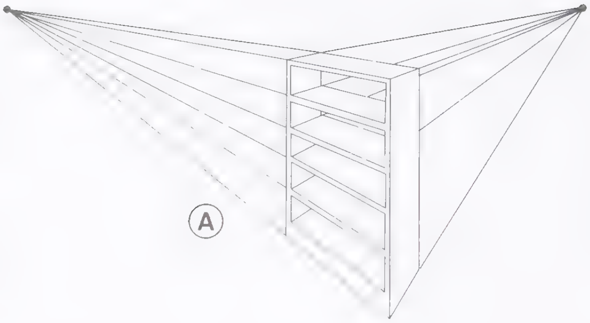
______________________ 8. One-point perspective

______________________ 9. Cavalier oblique drawing

______________________ 10. Two-point perspective

______________________ 11. Cabinet oblique drawing

______________________ 12. Three-point perspective



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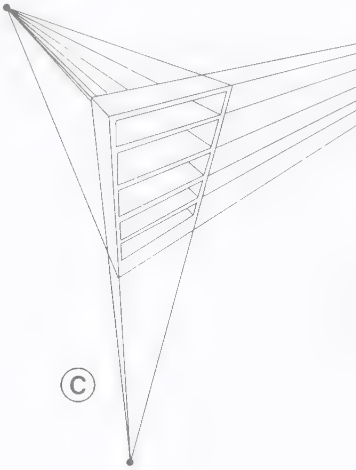

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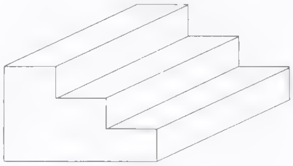

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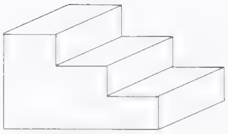

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CHAPTER 5

Print Components

A set of residential prints typically consists of several sheets of drawings and accompanying written documentation known as specifications. Each drawing and component of the specifications provides information about the house that must be properly interpreted to construct the desired design.

Drawings included in a set of residential prints describe the building lot, building size, and the materials used to construct the house. Various drawing representation methods are used to show the building as viewed from different directions. Drawings commonly included in a set of residential prints include plot plans, foundation plans, elevations, floor plans, and details.

TITLE BLOCKS

Each print sheet has an area bordered with a solid line that is reserved for written information about the house, builder, and architect. This area is the title block. See Figure 5-1. The title block is placed at the right or bottom margin of each print sheet to allow a tradesworker to read it easily while paging through the set of prints.

The title block indicates the sheet number and the total number of sheets contained in the set of prints. For example, the second sheet of a set of prints with a total of seven sheets is identified as "2 of 7." For larger sets of prints, the sheet number may be preceded by a letter to indicate the type of information contained on the sheet. Sheets containing electrical drawings may have an "E" prefix, sheets containing plumbing drawings may have a "P" prefix, and sheets containing heating, ventilating, and air conditioning (HVAC) drawings may have an "M" prefix. For example, the second sheet of a set of prints with a total of four sheets and containing electrical drawings is identified as "E2 of 4." Architectural drawing sheet numbers may be preceded by an "A."

The name of the architectural firm appears in the title block. The names of the owner and the builder may also be shown. For an architectural firm with several architects, the initials of the architect who created the drawings may be included. A space is provided in the title block for the architect's seal to be affixed to each print page. The date the drawings were created is also given in the title block. A project number, building number, address, or another form of location for the building may also be provided.

Space is provided in the title block for written descriptions of drawing revisions. Revisions may be coded with letters or numbers that appear in the title block and on the drawing to which they refer. The letter or number code is contained in a circle, square, or triangle. The code identifies the location of the revision. A date is noted next to each revision.

A set of residential prints typically includes several sheets of drawings that provide information about the house to be constructed.

Figure 5-1. *A title block on each print sheet provides information about the architect, owner, and location of the house.*

PLOT PLANS

Two types of drawings describe the building lot—the plat plan and the plot plan (also known as the site plan). A plat plan is an orthographic aerial view of the area in which the building lot is located. The shapes and locations of more than one building lot are defined on a plat plan. See Figure 5-2.

A plat plan is generally not included in a set of residential prints. A plat plan is used by the residential developer or builder to develop an area of ground for the construction of a subdivision or other type of residential community. Surveyors lay out the sizes and locations of building lots according to the plat plan. Electrical service lines, natural gas pipes, water services, sewer pipes, and streets are installed according to the plat plan.

The plat plan is different from a plot plan in that it contains information about all the building lots within a given geographic area. A plot plan provides specific information about the building lot for one house. See Figure 5-3. A plot plan is an orthographic aerial view of one building lot. A plot plan is included in a set of residential prints. Plot plans identify the property lines, location of the house on the lot, finished floor elevation, elevations and contour of the ground, utility locations, and easements.

Property Lines

The outside boundaries of the building lot are indicated by property lines. Property lines are either solid or broken lines. The length of each side of the building lot is noted along each property line. The compass direction indicating north, south, east, or west for each side of the building lot is also noted along the property lines.

Building lot corners are identified when laying out the property lines.

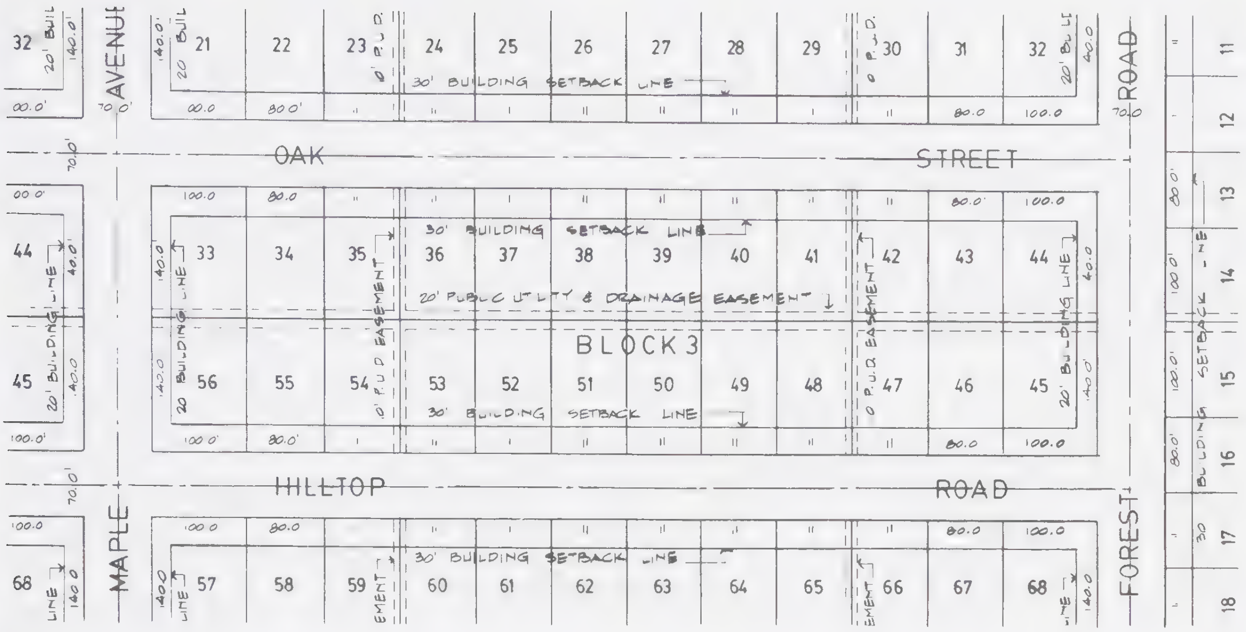


Figure 5-2. *A plat plan shows the shapes and locations of more than one building lot in a subdivision.*

Building Location

The outside of the house is outlined with object lines. Dimension lines from the property lines to the house outline indicate the location of the house on the building lot. Other items such as driveways, sidewalks, patios, porches, and fences are dimensioned from the property lines and house outline.

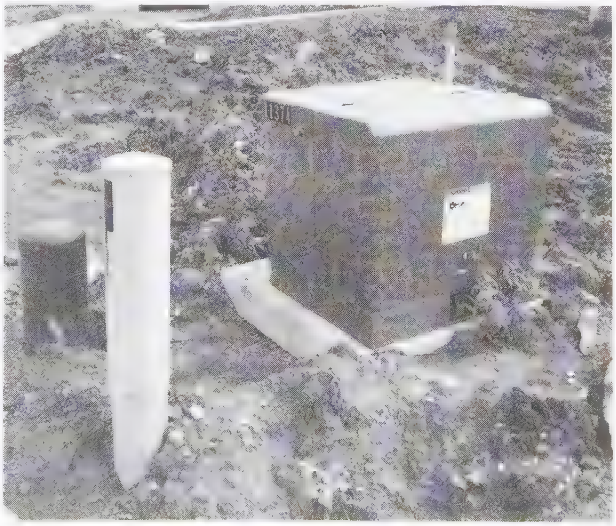
Elevation Dimensions

The contour of the ground on the building lot is shown with elevation dimensions. The existing slope and the planned finish grade of the building lot are indicated with contour lines. The elevation of the first floor level of the house is also indicated with elevation dimensions. The slopes of driveways and sidewalks are also shown on the plot plan.

A point of beginning is typically shown on a plot plan. An elevation dimension is a vertical measurement above or below the point of beginning. A benchmark on the actual building lot, such as a stake driven into the ground or point along the curb, represents the point of beginning.

Utility Locations

Locations of natural gas, water, and electrical services, and sanitary and storm sewers are indicated on plot plans. Specialty lines, abbreviations, and notations from the architect illustrate the utility services. In areas where a municipal water supply is not available, locations for septic fields and wells may be shown on the plot plan.



Locations of utilities, such as electrical and communication services, are indicated on plot plans.

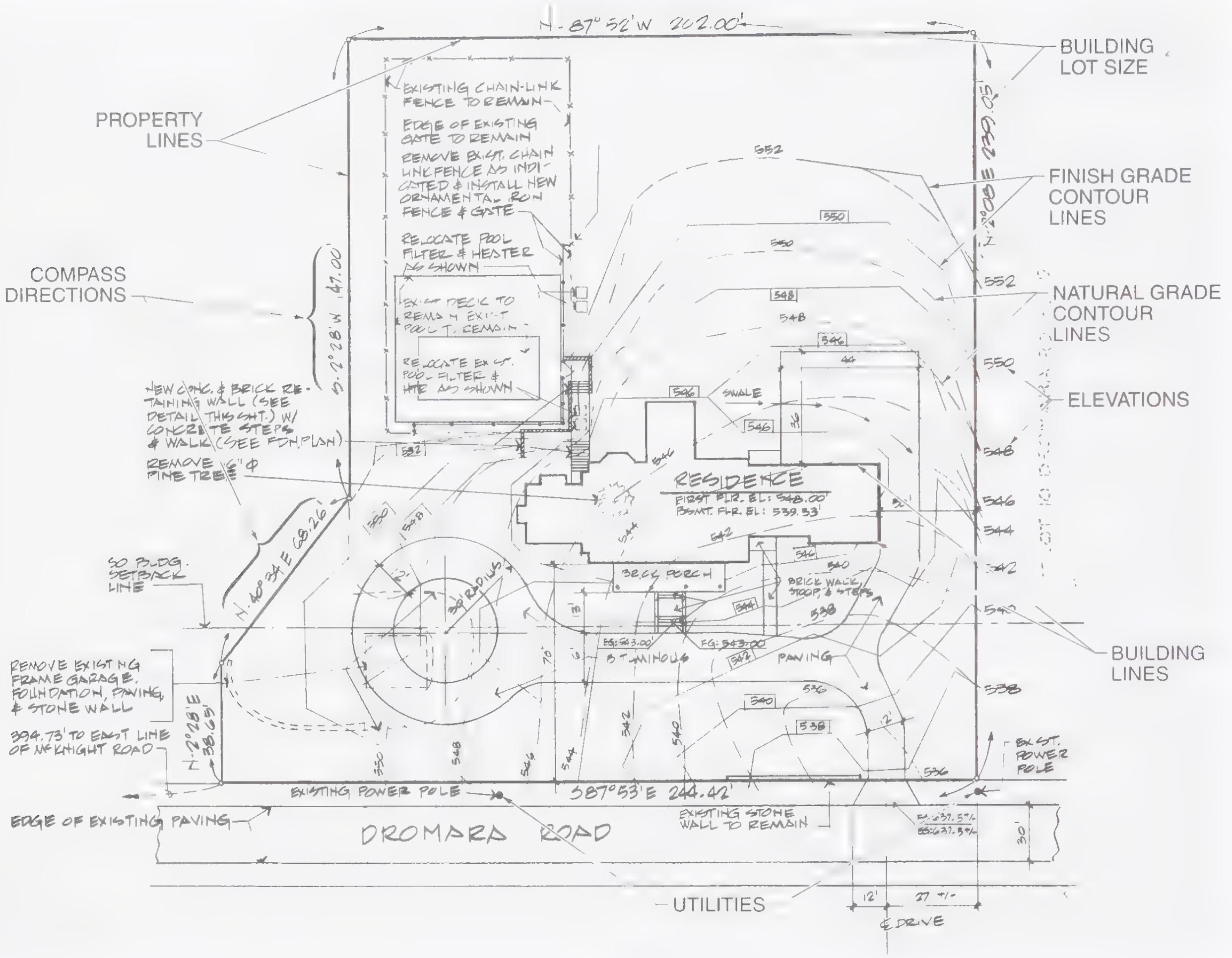
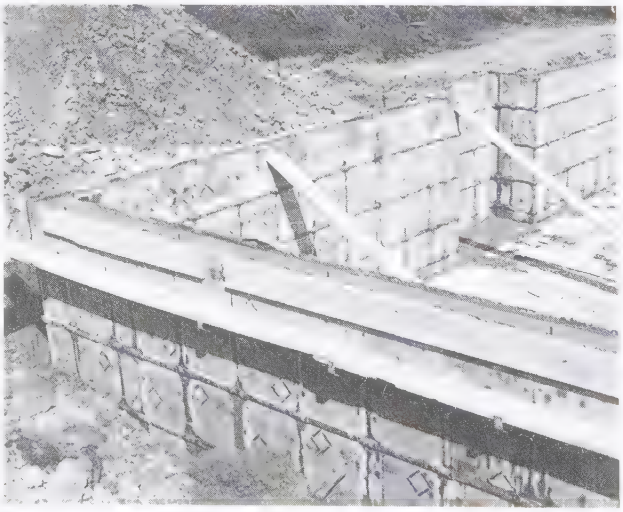


Figure 5-3. *A plot plan includes property lines, building lines, and utility locations. Contour lines show the elevations of the existing and planned finished grades of a lot.*

FOUNDATION PLANS

A foundation plan provides information about footing and foundation materials, dimensions, and foundation wall openings. See Figure 5-4. The foundation plan is either a section (if the house has a basement) or an orthographic aerial view (for houses without a basement). Some residential prints, such as for manufactured housing, may not have a foundation plan.

Foundation footings and walls serve many functions including structural support; creation of a level, straight, and square work surface; and a means for anchoring the house to a stable structure.



Information regarding foundation walls and footings is typically included on a foundation plan.

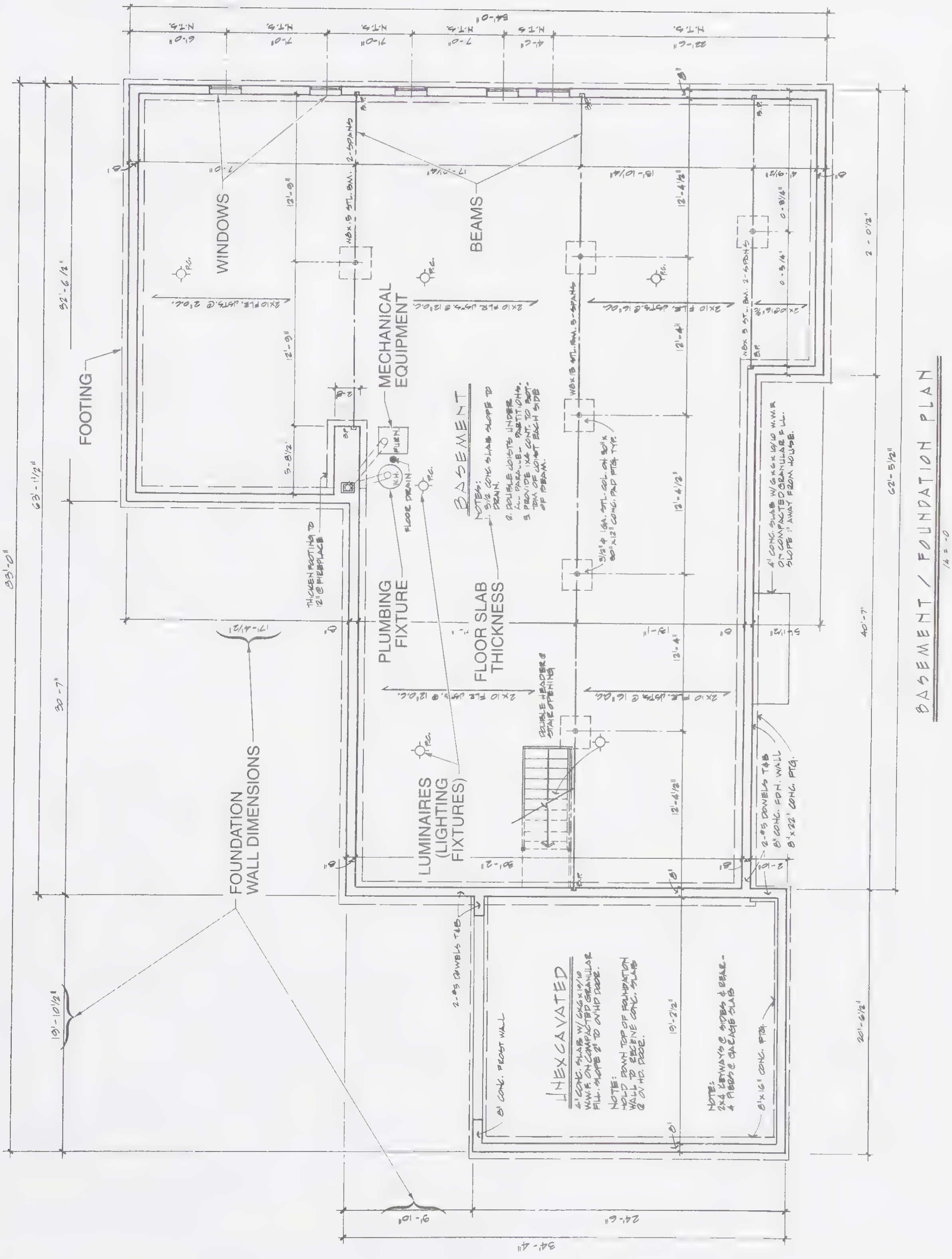


Figure 5-4. *Foundation plans include information regarding foundation materials, mechanical equipment, plumbing fixtures, and electrical devices and luminaires to be installed in the basement.*

Foundation Type

The foundation plan shows the method used to support the house framing. Foundation types include basements, concrete slabs-on-grade, piers and grade beams, piles, or other foundations. The construction materials used for the foundation are noted on the foundation plan. For houses with a basement, the support components for the first floor of the house, such as beams and columns, are shown on the foundation plan.

Foundation Dimensions

Exterior dimensions of the foundation are noted on the foundation plan. If the house has a basement, the thickness of the foundation walls and the sizes and locations of beams and columns are also indicated on the foundation plan. Dimensions for the thickness of the basement floor or the first floor concrete slab are also included. Centerline locations of other foundation systems, such as piers or piles, are furnished on a foundation plan.

Where the basement is finished to provide additional living areas, dimensions for interior partitions are shown on the foundation plan. General locations for electrical circuits, switches, and luminaires (lighting fixtures) are shown. Locations for water heaters, furnaces, air conditioners, and other mechanical equipment located in the basement are indicated. Plumbing pipe locations for both supply and waste piping may also be included on foundation drawings.

Foundation Openings

Doors, windows, and vents located in basement walls are described on the foundation plan. Horizontal dimensions to the edges or centers of the door, window, or vent openings are shown. The types and sizes of doors, windows, or vents are indicated by the architect.

Basement Finishes

Where the basement serves as a living area, the materials and dimensions for finishing the interior of the basement are indicated. The floor, wall, and ceiling finishes are described on the foundation plan.

ELEVATIONS

Exterior elevations are orthographic projections of the exterior of each side of a house. See Figure 5-5. Exterior elevations indicate exterior finish materials and dimensions. The sizes and types of doors and windows to be installed in exterior walls are also shown. Elevation dimensions pertaining to floor heights in the house and the ground around the house, similar to the information shown on a plot plan, may be provided. The roof type is also illustrated on exterior elevations. Interior elevations provide information about interior walls and partitions that require special finishes or fixtures.

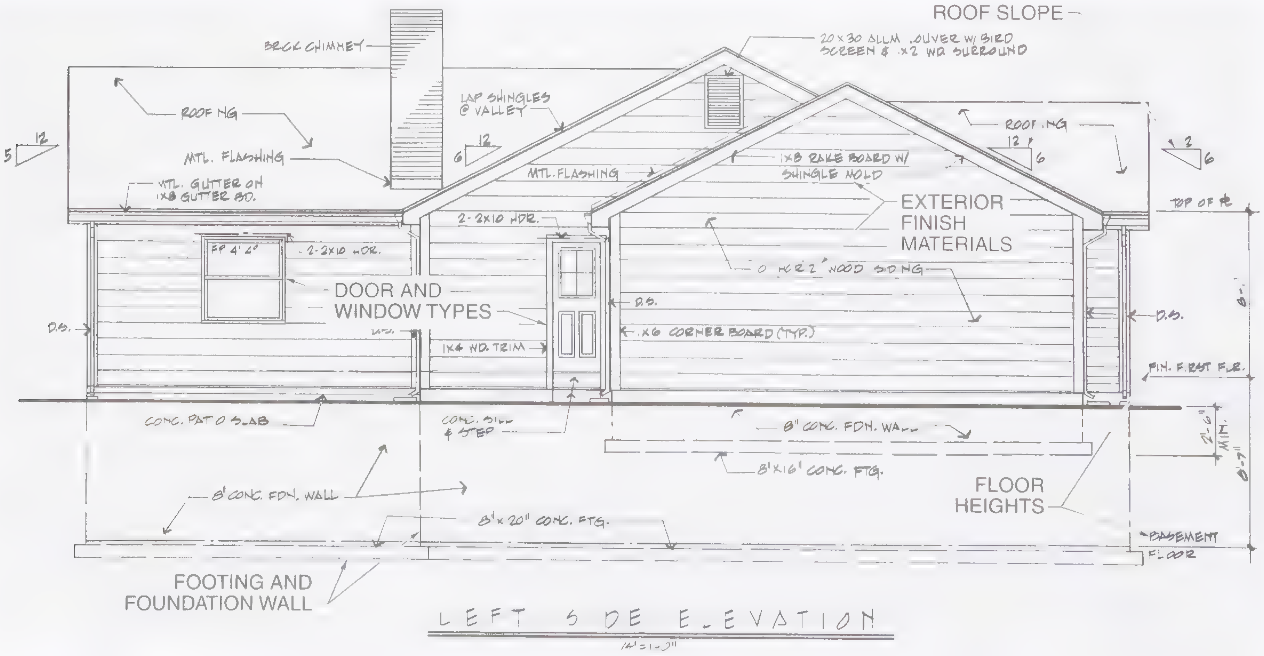


Figure 5-5. Exterior elevations are orthographic projections that show the exterior of a house.

Exterior Finishes

Exterior walls are covered on the outside faces with a variety of finish materials to protect the house interior from physical elements. Vinyl, aluminum, masonry, concrete, exterior insulation and finish systems (EIFS), plaster, and treated or painted wood or metal provide exterior protection. The materials to be applied and their locations are detailed on exterior elevations. Finishes for the surfaces of porches and sidewalks may also be indicated. Exterior finish fixtures and ornamentation, such as luminaires, decorative items, and trim moldings are also shown on elevations.

Exterior Doors, Windows, and Openings

Exterior elevations indicate the types of windows and doors that are installed in the exterior framed openings. The width and height of each window are shown, along with the type of window to be installed. Door style and finish are noted by the architect on elevations. Location dimensions for the doors and windows in exterior walls are included on floor plans.

Ventilation openings in the exterior walls and roof are shown on exterior elevations. The type of vent installed is described and the vent location may also be indicated. Ventilation openings create an airflow through unheated and uncooled areas. The air movement prevents condensation from forming in these areas.

Elevation Information

Dimensions indicating floor heights and elevations to the top of foundation walls are included on elevations. For a house with a basement, the basement walls and footings are shown with hidden lines. The height and thickness of walls and footings are indicated. Heights and slopes of driveways and sidewalks may also be indicated on elevations.

Roof Type

The type of roof to be constructed is determined from exterior elevations. The slope for each part of the roof is indicated on elevations with a slope diagram. The type of finish roofing material is also noted.

Interior Walls

Interior elevations of interior walls and partitions are provided where a special interior finish is installed. See Figure 5-6. Kitchens, bathrooms, and other locations where special wall conditions exist are detailed on interior elevations. Interior elevations show the locations, dimensions, and finishes of cabinetry, electrical devices and luminaires, and plumbing fixtures. Interior elevations may be referenced on the floor plan with a letter or number code. Interior elevations may be included on the same sheet with other drawings or may appear on a separate sheet.

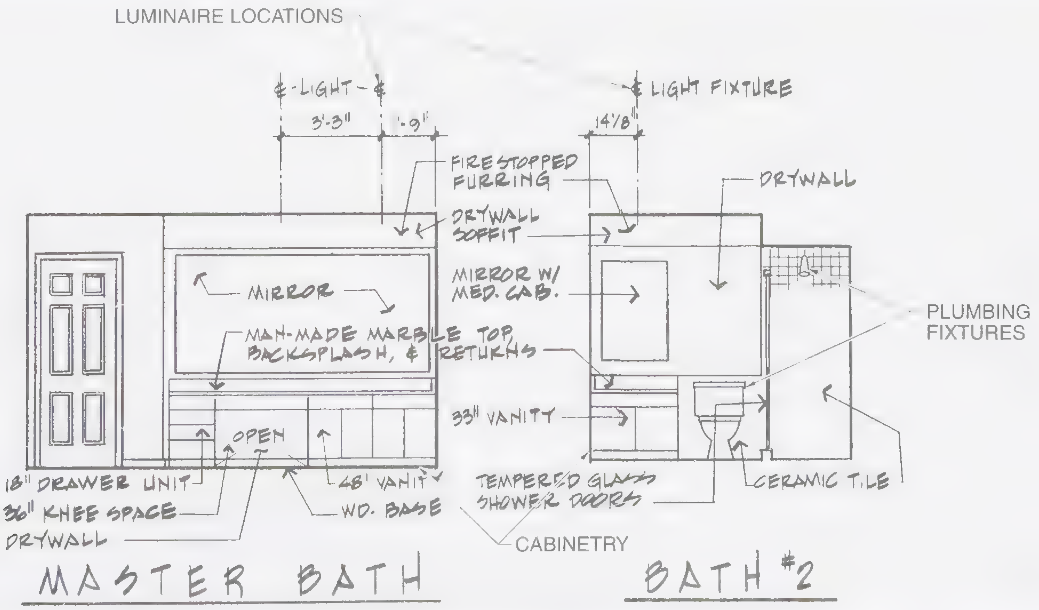


Figure 5-6. Interior elevations typically contain information regarding cabinets and luminaires.

FLOOR PLANS

A floor plan is a section with a cutting plane taken 5′-0″ above the floor level. A floor plan provides more construction information about a house than other drawings in a set of residential prints. See Figure 5-7. Dimensions, including room sizes, are provided for constructing the interior partitions and exterior walls and for creating the proper size door and window openings at the proper locations. For multistory houses, a separate floor plan is provided for each floor. The locations and types of interior and exterior fixtures and finishes are also shown on a floor plan.

Room Dimensions

Dimensions of the overall size of the house and dimensions used to properly locate interior partitions are provided on a floor plan. The name of each room is also noted, such as the kitchen, bedroom, bathroom, and living room.

Framing Information

For wood- and metal-framed houses, the size and on-center spacing of framing members are shown on floor plans. For masonry and concrete walls, the wall thickness and construction materials are noted on floor plans.

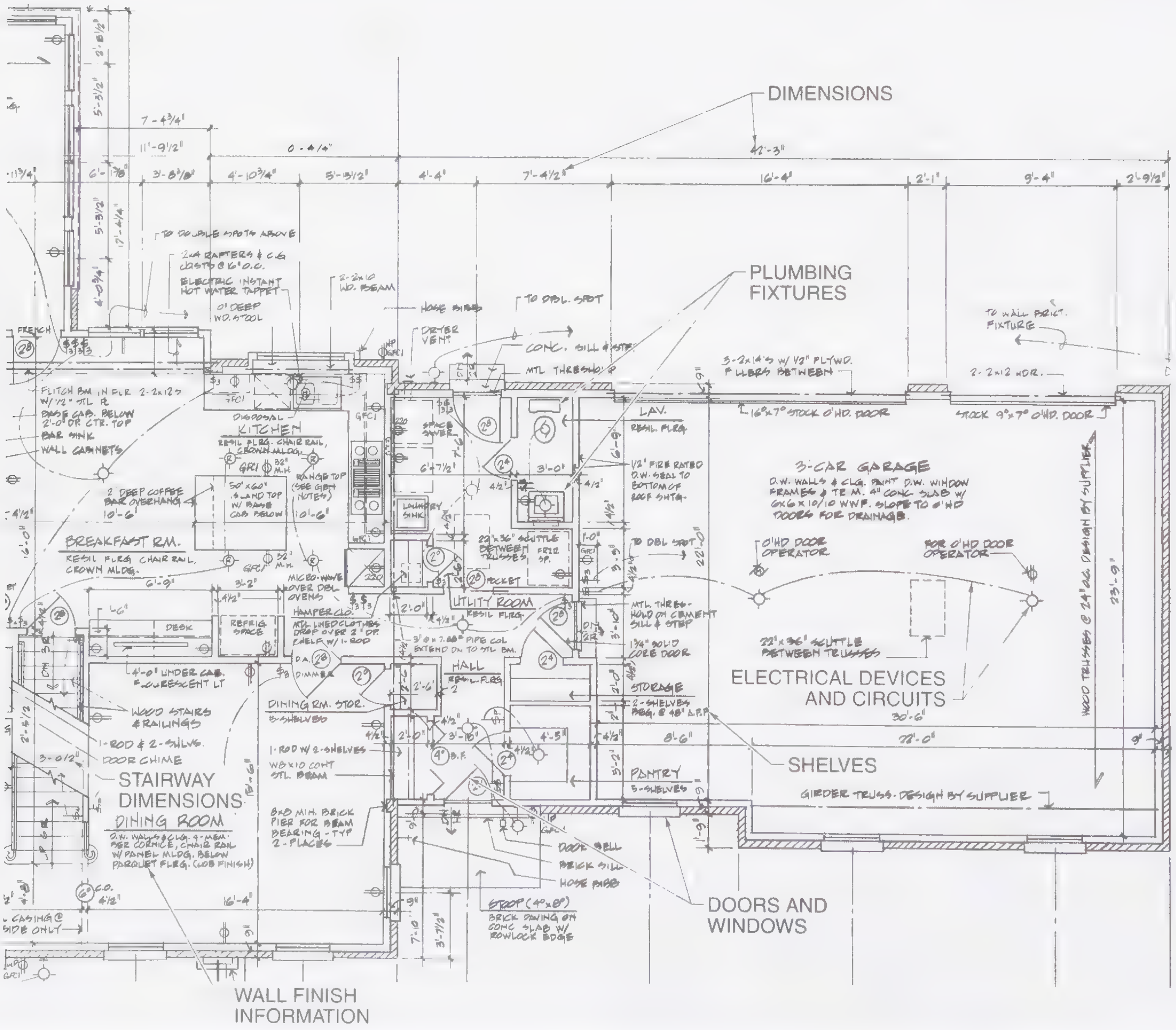


Figure 5-7. *Floor plans contain more construction information than other drawings in a set of residential prints.*

Opening Information

The primary source of information about the sizes and locations of wall and floor openings is the floor plan. An architect notes the size of each interior and exterior door in feet and inches. Locations for doors, windows, and other required openings are provided. Types of doors are shown, along with the swinging or sliding direction of each door.

Location and Size. Door and window locations and sizes are included on floor plans for interior partitions and exterior walls. The center or edge of the opening is the reference point for horizontal placement of doors and windows. A cross-reference between the floor plan and exterior elevations is helpful in determining exterior wall opening sizes and locations.

Openings for stairways and attic access scuttles are shown on floor plans. The size and location of stairway openings are dimensioned. Scuttle opening size is indicated on floor plans, but the location may change slightly depending on the ceiling and roof framing system and layout.

Schedules. A schedule is a detailed list on a print that provides information regarding the size, type, and finish of each door and window to be installed. When a door or window schedule is provided in a set of prints, each door and window opening on the floor plan is given a letter or number code that is keyed to the schedule. Several openings in a house can have the same code on the floor plan, indicating identical size openings and finishes.

Cabinets and Fixtures

Cabinets, electrical devices and luminaires, and plumbing fixtures are shown on floor plans. Object lines represent cabinets below the cutting plane. Cabinets above the cutting plane of the floor plan are shown with hidden lines. Locations for luminaires, kitchen appliances, and electrical receptacle outlets, switches, and circuits are shown with symbols. The switching arrangement for each luminaire is indicated. Plumbing fixtures, such as water closets, sinks, and lavatories are also shown with symbols. Plumbing pipes may also be shown on floor plans.

The most common scale for residential floor plans is 1/4″ = 1′-0″, which is 1/48 of the actual size. For larger houses, a 1/8″ = 1′-0″ scale may be used.

Finish Information

Interior finish materials for each room of the house, including floor, wall, and ceiling finishes, are noted on a floor plan. Information about the finish material may include the color and manufacturer's identification code for each item.

Finish shelving materials and types are indicated on the floor plan, including the locations and number of shelves to be installed. Special finish moldings or trim members to be installed are also noted on the floor plan.

DETAILS

Details are scaled plan views, elevations, or sections drawn at a larger scale to show special features. See Figure 5-8. Details may be placed on the same sheets as the plot plan, floor plan, or elevations or included on a separate sheet in the set of the prints. When the detail is included on a separate sheet, a number or letter code may be placed on both the source sheet and the detail to indicate the relationship between the two drawings.

Finish details may be provided for stairway handrails and other special features.

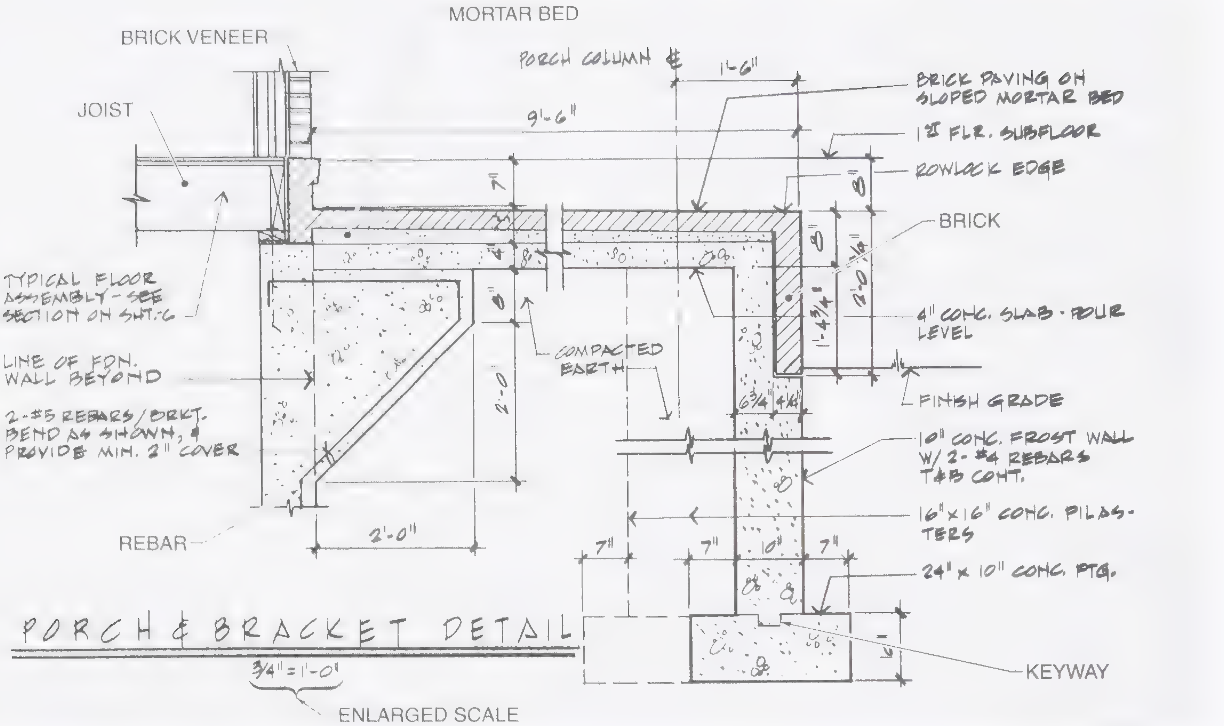


Figure 5-8. *Details are enlarged-scale drawings showing specific items that cannot be shown clearly on other drawings.*

Foundations

Height, depth, and thickness dimensions for foundation components are provided on details. Information regarding special openings, blockouts, ledges, offsets, and other structural supports required in a foundation are also shown on details. Foundation details provide specific information about reinforcing steel for foundation footings and walls. Rebar is the most common type of reinforcing steel used for concrete foundation footings and walls.

Framing

Framing details may be provided to describe unique framing situations that can occur in walls, floors, ceilings, porches, stairways, decks, or other parts of a house. Interior and exterior finish are also noted on typical details.

Finish

Finish details show interior and exterior moldings, finishes, and cabinetry. Where custom moldings are to be installed, full-scale details may be provided to show the profile of custom moldings.

SPECIFICATIONS

Specifications are a written supplement to a set of prints that provide additional building information. See Figure 5-9. Specifications may be contained on one or two pages for a set of residential prints or included directly on the various print sheets. Specifications are larger and of more importance for commercial construction than for residential construction.

Structural Information

Lumber, steel, concrete, and other construction materials for residential construction must meet structural strength requirements detailed in the applicable building code. Standard load and support capacities have been established for each type of construction material. The structural requirements of the construction materials used for the construction of a house are included in the specifications.

An architect is responsible for writing the specifications so that they are consistent with the prints.

CARPENTRY AND LUMBER

Floor joists to be 2″ × 10″ or 2″ × 12″, according to plan, No. 2 or better yellow pine. Partition studs to be 2″ × 4″ K.D. construction grade. Ceiling joists and roof rafters to be construction or engineered roof trusses of yellow pine. Subfloor to be 3/4″ thick plywood. Roof sheathing to be 1/2″ thick plywood.

All exterior trim to be Upson trim-bilt or equivalent exterior grade lumber of sizes and thickness as shown on plans. Insulite or Masonite lapsiding or board-and-batten siding to be used where siding is shown, unless other siding is shown on plans. Family room paneling to be 1/4″ × 4′ × 8′ birch plywood.

CONCRETE WORK

Concrete for footings and foundation walls for house and garage to be 5 sacks cement per cubic yard of concrete aggregate. Provide concrete footings and foundations walls as indicated on drawings. Basement floor to be 3″ thick concrete laid on 3″ crushed rock. Open porch floors to be 4″ thick concrete laid over level ground and reinforced with #4 reinforcing rods or 6 × 6, 10 × 10 wire mesh. Garage floor to be 4 thick concrete sloped toard garage door.

STRUCTURAL INFORMATION

FINISH INFORMATION

15. DECORATING: *(Paint, wallpaper, etc.)*

Rooms	Wall Finish Material and Application	Ceiling Finish Material and Application
Kitchen	Paint 3 coats	Paint 3 coats
Bath	Ceramic tile, Paint 3 coats above	Paint 3 coats
Other	Paint 3 coats	Paint 3 coats

Additional information

16. INTERIOR DOORS AND TRIM:

Doors type H.D. Flush & louvered material Flush Oak, Louvered Pine thickness 1 3/8 - 1 3/4

Door trim type Solid material oak Base type stock material oak, size n/a

Finish doors Stain & varnish, trim stain & varnish

Other trim *(item, type and location)* mantel trim oak stain & varnish

Additional information

17 WINDOWS:

Windows type D.H.& casement make Andersen, material Pine sash thickness 1 3/8

Glass grade Insulating, ☐ sash weights, ☐ balances type Spring, head flashing n/a

Trim type Wood casing, material Oak Paint Stain & varnish, number coats 2

Weatherstripping type Friction, material st. st. Storm sash, number n/a

Screens ☒ full ☐ half type aluminum, number n/a, screen cloth material n/a

Basement windows type n/a, material n/a, screens, number n/a, Storm sash, number n/a

Special windows

Additional information

18. ENTRANCES AND EXTERIOR DETAIL:

Main entrance door material Pease Steel Clad, width 3′-0″, thickness 1 3/4″ Frame material Pine, thickness 1 3/8″

Other entrance doors material Pease Steel Clad width 3′-0″, thickness 1 3/4″ Frame material Pine, thickness 1 3/8″

Head flashing n/a Weatherstripping type Friction saddles n/a

Screen doors thickness n/a″, number n/a, screen cloth material n/a Storm doors thickness n/a″, number n/a

Combination storm and screen doors thickness 1 1/8, number 2, screen cloth material Aluminum

Shutters ☐ hinged ☐ fixed Railings Wood, Attic louvers 2 #2 Pine

Exterior millwork grade and species D Select (West Coast) Paint Pigmented stain, number coats 2

Additional information Oil paint windows, doors, and trim

19. CABINETS AND INTERIOR DETAIL:

Kitchen cabinets, wall units material Oak, lineal feet of shelves 28′, shelf width 12″

Base units material Oak, counter top Laminated plastic edging Laminated plastic

Back and end splash Broderick 3309 Finish of cabinets, number coats

Medicine cabinets make, model

Other cabinets and built in furniture

Additional information 2 Bathroom vanities Laminated plastic top Oak stain & varnish

Figure 5-9. *Specifications provide written descriptions of construction materials and practices.*

Finish Information

The materials and methods used to finish the interior and exterior of a house are included in the specifications. Standard sheets with blanks that can be filled in are commonly used. Working with the builder and architect, an owner selects colors and materials for wall, ceiling, and floor finishes and documents them on this sheet. Allowances for various fixtures and appliances may also be included in the specifications.

General Conditions

The general conditions are a legal agreement between the owner and builder regarding the conditions of construction. The items furnished by the builder and items provided by the owner are detailed in the general conditions. Specific requirements for electrical, plumbing, and heating and air conditioning equipment are also described in the general conditions of the specifications. See Figure 5-10.

GENERAL NOTES

1. Double all joists under partitions parallel to joist span.
2. Triple all joists under bearing partitions parallel to joist span.
3. Provide one layer of 1/2" drywall all walls and ceilings.
4. All doors to be 6 panel or 3 panel molded face.
5. Fire stop all dropped ceilings and soffits.
6. All nailing to comply with BOCA Basic Building Code Appendix M.
7. Drywall installation to be in accordance with Gypsum Assoc. recommended practice for thickness, nailing and taping on correct stud spacing. Use water resistant drywall at bathtubs and shower areas.
8. Provide two 2 × 12 headers over exterior openings except as indicated.
9. Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall at penetrations or utility services through walls, floors and roofs and all other openings in the exterior envelope shall be sealed in an approved manner.
10. Special casing on Foyer side of cased openings.
11. Smoke detectors to be A.C. wired, U.L. listed, installed in accordance with NFPA.
12. No interior finish material shall have a flame spread rating over 200.
13. Paint garage and basement with one coat latex, flat.
14. Range top to be Jenn-Air 3000 series "Tri-convertible" range/grill unit.
15. Double ovens to be self-cleaning.
16. Resilient flooring to be "Armstrong Designer Solarian" or approved equal.

Figure 5-10. *Specifications include the general conditions of construction.*

REVIEW QUESTIONS

Chapter 5

Print Components

Name ______________________________ Date ______________

True-False

T F 1. A plat plan is typically included in a set of residential prints.

T F 2. A plot plan is an orthographic projection.

T F 3. Elevations include contour lines for grading the building lot.

T F 4. Foundation plans use hidden lines to show foundation walls.

T F 5. The principal source of information for locating door and window openings in interior walls is a floor plan.

T F 6. Custom moldings may require full-scale details.

Multiple Choice

______________ 1. A plot plan ___.
- A. describes all the building lots within a subdivision
- B. shows room layout
- C. is different from a site plan
- D. provides information about utility locations and easements

______________ 2. Beams and columns that support the first floor of a house are shown on a(n) ___.
- A. plot plan
- B. foundation plan
- C. floor plan
- D. elevation

______________ 3. Elevations include information about ___.
- A. exterior finish materials
- B. roof slope
- C. interior wall finishes
- D. all of the above

______________ 4. A schedule on residential prints is used to ___.
- A. determine the building lot size
- B. provide information about doors and windows
- C. track the progress of various tradesworkers
- D. assist the owner in selecting finish materials

Matching

The following information is most often included on a specific component of residential prints. Write the letter next to each item that corresponds to the print component on which the information appears.

______	1. Property lines	A. plot plan
______	2. Basement floor thickness	B. foundation plan
______	3. Exterior wallcovering materials	C. elevation
______	4. Roof vent types and locations	D. floor plan
______	5. Types of interior closet doors	E. detail
______	6. General conditions	F. specifications
______	7. Available utility service locations	
______	8. Compass directions for each side of the building	
______	9. Names of first-floor rooms	
______	10. Concrete footing reinforcement location	
______	11. Number of closet shelves	
______	12. Basement interior finish materials	
______	13. Structural material requirements	
______	14. Schedule letters and numbers	

Completion

______ 1. Interior partition locations are shown on the ___.

______ 2. Floor-mounted cabinets are shown with ___ lines.

______ 3. A detail is drawn at a(n) ___ scale than other drawings in a set of residential prints.

______ 4. Orthographic projections of each exterior wall of a house are called exterior ___.

______ 5. The abbreviation "E" in the title block of a print sheet indicates that the drawings on the sheet refer to ___ work.

______ 6. The direction of swinging doors is indicated on a(n) ___ plan.

______ 7. Revisions of a plan are noted in the ___.

Identification

Identify the six components of a set of residential prints.

_______________ 1. Elevation

_______________ 2. Foundation plan

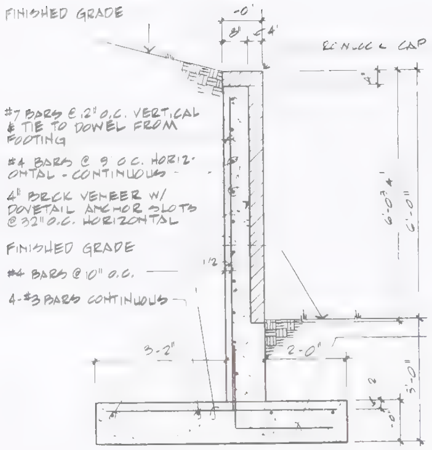
_______________ 3. Specifications

_______________ 4. Plot plan

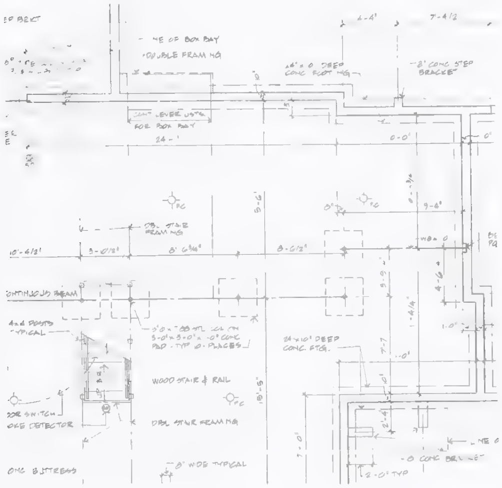
_______________ 5. Floor plan

_______________ 6. Detail

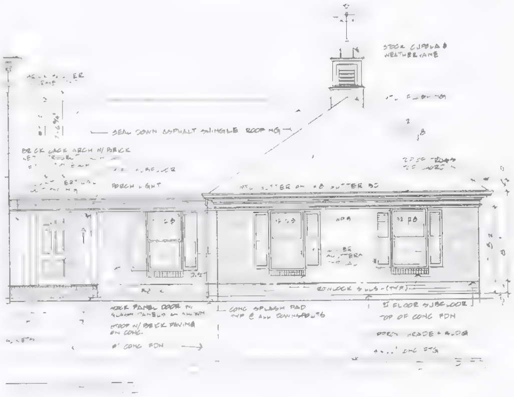
(A)



(B)



(C)



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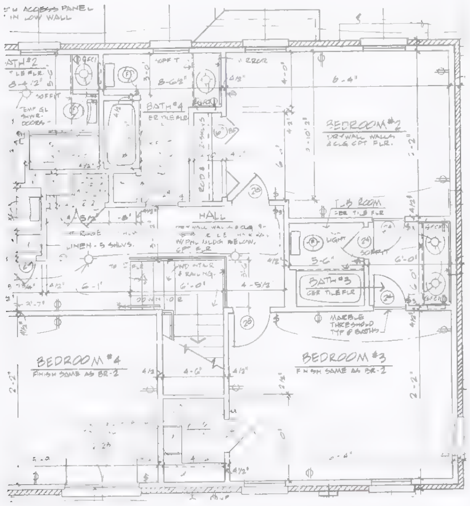
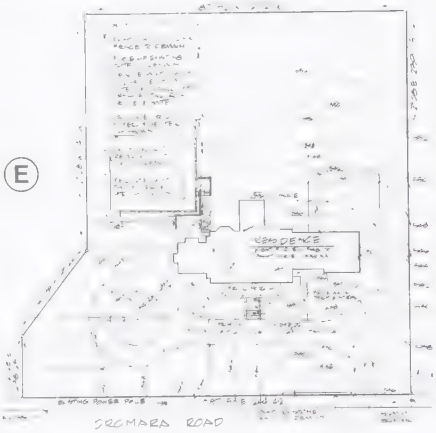


(E)



(F)

15 DECORATING (Paint, wallpaper, etc.)

Rooms	Wall Finish Material and Application	Ceiling Finish Material and Application
Kitchen	Paint 3 coats	Paint 3 coats
Bath	Ceramic tile, Paint 3 coats above	Paint 3 coats
Other	Paint 3 coats	Paint 3 coats

Additional information

16 INTERIOR DOORS AND TRIM

Doors: type H.D. Flush & louvered — material Flush Oak, Louvered Fine — thickness 1 3/8 - 1 3/4
Door trim: type Solid — material oak — Base: type stock — material oak — size n/a
Finish: doors Stain & varnish — trim stain & varnish
Other trim (item, type and location) mantel trim oak stain & varnish
Additional information

17 WINDOWS

Windows: type D.H.& casement — make Andersen — material Pine — sash thickness 1 3/8
Glass: grade Insulating — ☐ sash weights ☐ balances, type Spring — head flashing n/a
Trim: type Wood casing — material Oak — Paint Stain & varnish — number coats 2
Weatherstripping: type Friction — material st. st. — Storm sash, number n/a
Screens: ☑ full ☐ half; type aluminum — number n/a — screen cloth material n/a
Basement windows: type n/a — material n/a — screens, number n/a — Storm sash, number n/a
Special windows
Additional information

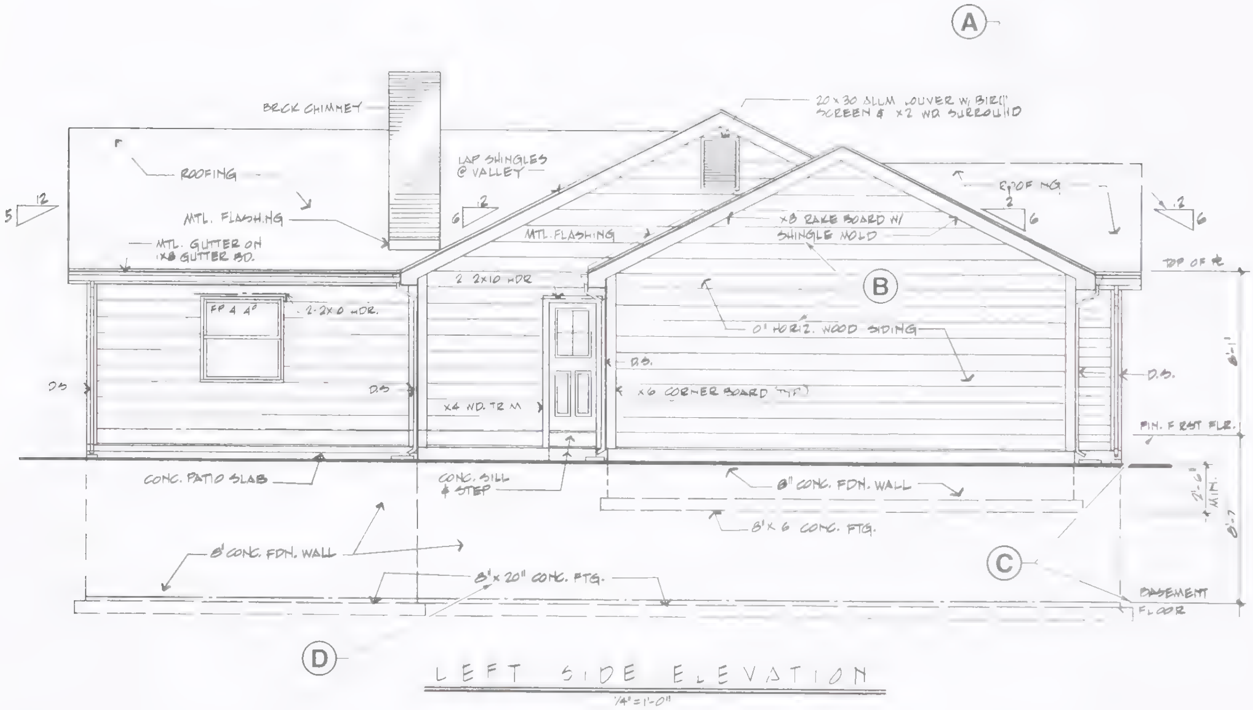
Identify the parts of the exterior elevation.

_______________ **7.** Exterior finish materials

_______________ **8.** Footing dimension

_______________ **9.** Roof slope

_______________ **10.** Floor heights



6 Plot Plans

Dimensions and notations regarding the building lot and location of the house on the lot are shown on residential plot plans. The plot plan is submitted to a title company for verification of property ownership. A clear title of ownership is required before a building permit can be issued or a construction loan can be obtained. The house, garage, driveways, sidewalks, and other structures are constructed on the lot according to the dimensions shown on the plot plan. Dimensions for both vertical and horizontal placement are noted. In addition to this information, the availability and locations of utility services are also shown on the plot plan.

GEOGRAPHIC DIVISIONS

Parcels of land in the United States are divided and identified by township, range, section, and quarter section. Names and numbers of these parcels appear on plot plans to provide a legal description of the property location.

Townships, Ranges, and Sections

A gridwork of imaginary lines crisscrosses the United States in a north-south and east-west pattern. See Figure 6-1. The north-south lines are meridians and the east-west lines are baselines. The squares formed by the north-south and east-west lines are 36 miles on each side. The squares are further divided into 36 squares that are 6 miles long on each side. Each of the 36 squares is a township, which is abbreviated with the letter "T." Townships are named or numbered for identification. Townships in a north-south column are called a range (R). For example, a township three columns to the east of a meridian is in Range 3 East, which is abbreviated R3E. Townships in an east-west row are identified by their northerly or southerly relationship to the baseline. For example, a township two rows north of the baseline is noted Township 2 North, which is abbreviated T2N. The entire description of a township three columns to the east of a meridian and two rows north of the baseline is T2N, R3E.

Townships are subdivided into sections, which are squares measuring 1 mile on each side. Sections within a township are numbered from 1 to 36, beginning in the northeast corner of the township and reading right to left for sections numbered 1 through 6. Section 7 is located directly south of section 6 and the section numbers in this row (sections 7 through 12) are read from left to right. Remaining sections are numbered and read following the same system.

Sections are subdivided into four equal squares known as quarter sections. Quarter section corners are marked with a permanent reference point called the point of beginning (POB).

Plot plans provide information regarding the location of the house on the lot and the utility services.

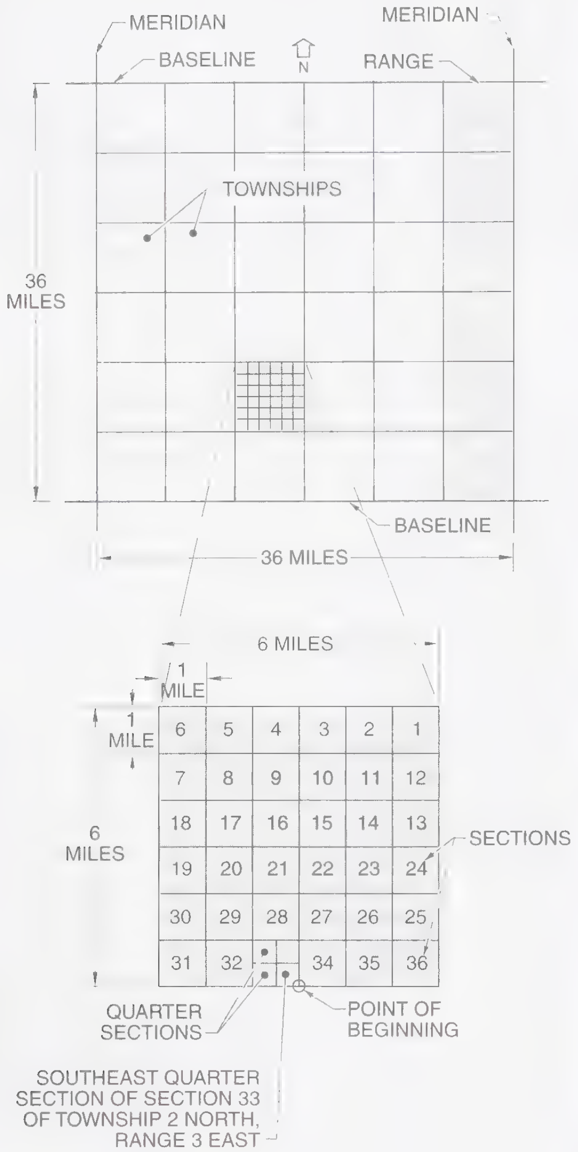


Figure 6-1. Geographic divisions into townships, ranges, sections, and quarter sections provide location identification for building lots.

PROPERTY LINES

Property lines on residential plot plans show the outside boundaries of a building lot. See Figure 6-2. Property lines may be solid or dashed. They are curved or straight, following the shape of the building lot. The location, direction, and length of each property line are noted on the plot plan.

One section, which measures 1 mile on each side, is equal to 640 acres.

Location

For a subdivision, a number may be provided on the plot plan indicating the number of the building lot. Numbers are also provided for adjacent lots. The width, centerline, and name of the street or road that provides access to the house are also shown. The distance to the closest adjacent cross streets may also appear on the plot plan.

A point of beginning is used by surveyors to begin measurements for establishing building lot locations. In urban areas, a point of beginning may be located by street intersections at corners or street centerlines. In rural areas, the point of beginning is marked at the quarter section divisions with a steel stake or concrete marker. The location of the point of beginning is noted on the plot plan.

Measurements are made from the point of beginning to establish the building lines. The distances from the point of beginning to the property lines are expressed using feet and inches or using decimal foot values in tenths and hundredths of a foot.

Compass Directions. The primary directions denoting property line direction are north and south. The direction of north is noted on a plot plan using an arrow pointing north with an "N" along the arrow.

On plot plans, letters denoting direction and angle measurements are shown along property lines to indicate their compass directions. The primary direction of a property line is indicated first—either north (N) or south (S). The letter representing the primary direction is followed by a compass reading (in degrees and minutes). The compass reading indicates the angle between the property line and the north-south reference line. This compass reading will not exceed 90°. The secondary direction follows the compass reading and is either east (E) or west (W). For example, a reading of N 7°-45′ E indicates a property line that forms an angle of seven degrees and forty-five minutes to the east of the north-south reference line, headed in a northerly direction. The notation is read as seven degrees, forty-five minutes east of north.

In addition to the direction and angle measurement along each property line, an angle dimension may be noted at the intersection of property lines. An angle dimension indicates the angle (in degrees and minutes) that is created by the property lines.

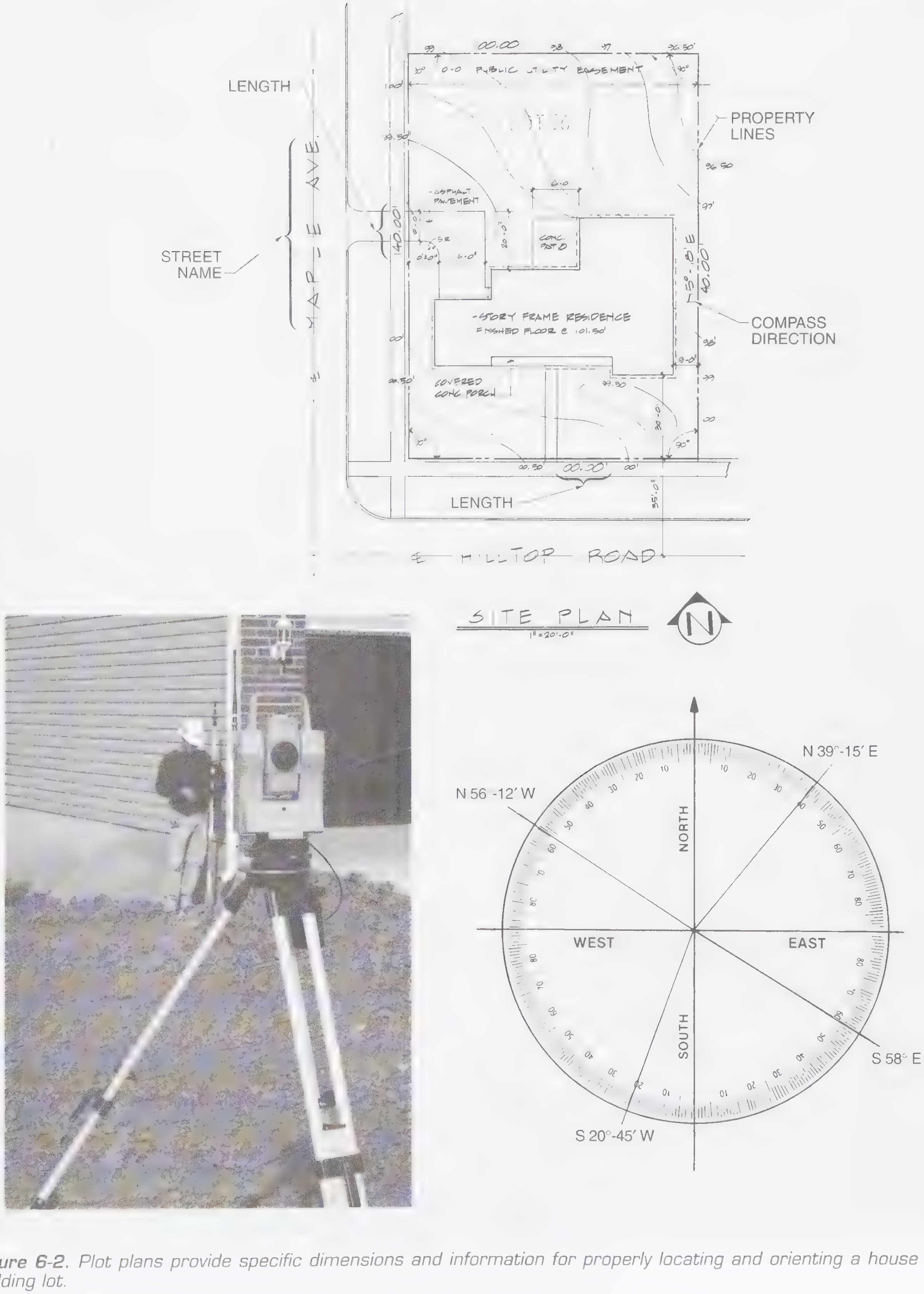


Figure 6-2. Plot plans provide specific dimensions and information for properly locating and orienting a house on a building lot.

Dimensions

Dimensions of property lines are shown on the plot plan. Dimensions are shown along the property lines, or extension and dimension lines are used. Property line dimensions are expressed in feet and inches or feet and tenths and hundredths of a foot. Dimensions for a curved or circular section of a property line are shown with a radius symbol.

Because of the sizes of the items shown, plot plans are created at a smaller scale than other drawings in a set of residential prints. Common drawing scales for residential plot plans are 1″ = 20′-0″, 1″ = 30′-0″, or smaller if the building lot is very large.

An engineer's scale or civil engineer's scale is used for scaling dimensions on a plot plan. See Figure 6-3. The scale is triangular, has six faces, and has a similar appearance to an architect's scale with each side being 12″ long.

Scales on an engineer's scale are 1″ = 10′-0″, 1″ = 20′-0″, 1″ = 30′-0″, 1″ = 40′-0″, 1″ = 50′-0″, and 1″ = 60′-0″. There is one scale on each edge and the scale on each edge is read in one direction only. There are no inch divisions of a foot on an engineer's scale.

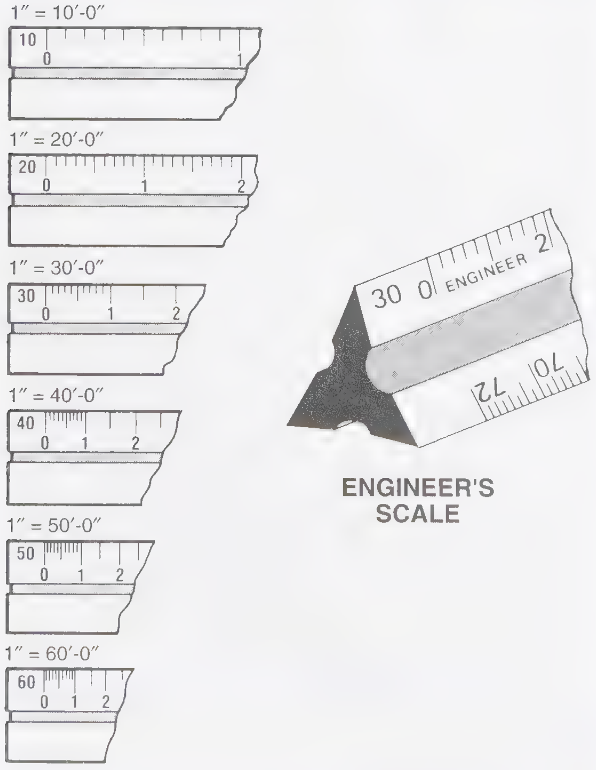


Figure 6-3. An engineer's scale is used to scale lines on a plot plan.

PROPERTY ELEVATIONS

In addition to location and length dimensions, plot plans also provide information about the height of slopes and contours of grade on the building lot. The height of an object is referred to as its elevation (EL). The elevations of the building lot have a direct effect on the building appearance, connections to various utilities, and surface water runoff.

The United States Coast Guard has established the average elevation between high and low tide, which is known as the mean sea level. See Figure 6-4. The elevation of mean sea level is established as elevation 0.00′ (EL 0.00′). Other elevations are based on their distance above or below mean sea level. Elevations related to mean sea level are called true elevations.

For ease in determining elevations at a particular job site, a stationary point can be created at a convenient location and given an elevation of 100.00′. Using an elevation of 100.00′ eliminates the need for calculating elevations with negative numbers (elevations below mean sea level) and simplifies most elevation calculations. Even though the elevation measurements are accurate, they are called false elevations because they are not related to the mean sea level elevation.

Datum Point

A datum point is a reference point for all elevations. A datum point is established by surveyors or civil engineers on a very stable object, such as a brass plate set in a concrete slab or building cornerstone, to provide a solid and stable reference point that does not move.

Additional reference points, known as benchmarks (BM), are provided at locations convenient to building sites. See Figure 6-5. Each benchmark is marked with an elevation. The location and elevation of a benchmark is shown on the plot plan. Benchmarks may be stakes or points in the street or on the curb. The building lot elevations shown on the plot plan are related to the benchmark.

One or two elevations may be indicated at the corners of a building lot on a plot plan. When one elevation is shown at a corner, the elevation of that point is to remain unchanged after construction is completed. When two elevations are shown, one is identified as the natural grade and the other is identified as the finish grade. The natural grade, also known as the existing grade, is the elevation of a point before construction begins. The finish grade is the final elevation of that point after construction is completed. For example, a lot corner marked N.G. 100.00′/F.G. 98.92′ requires that the corner be lowered 1.08′ from the natural grade to the finish grade.

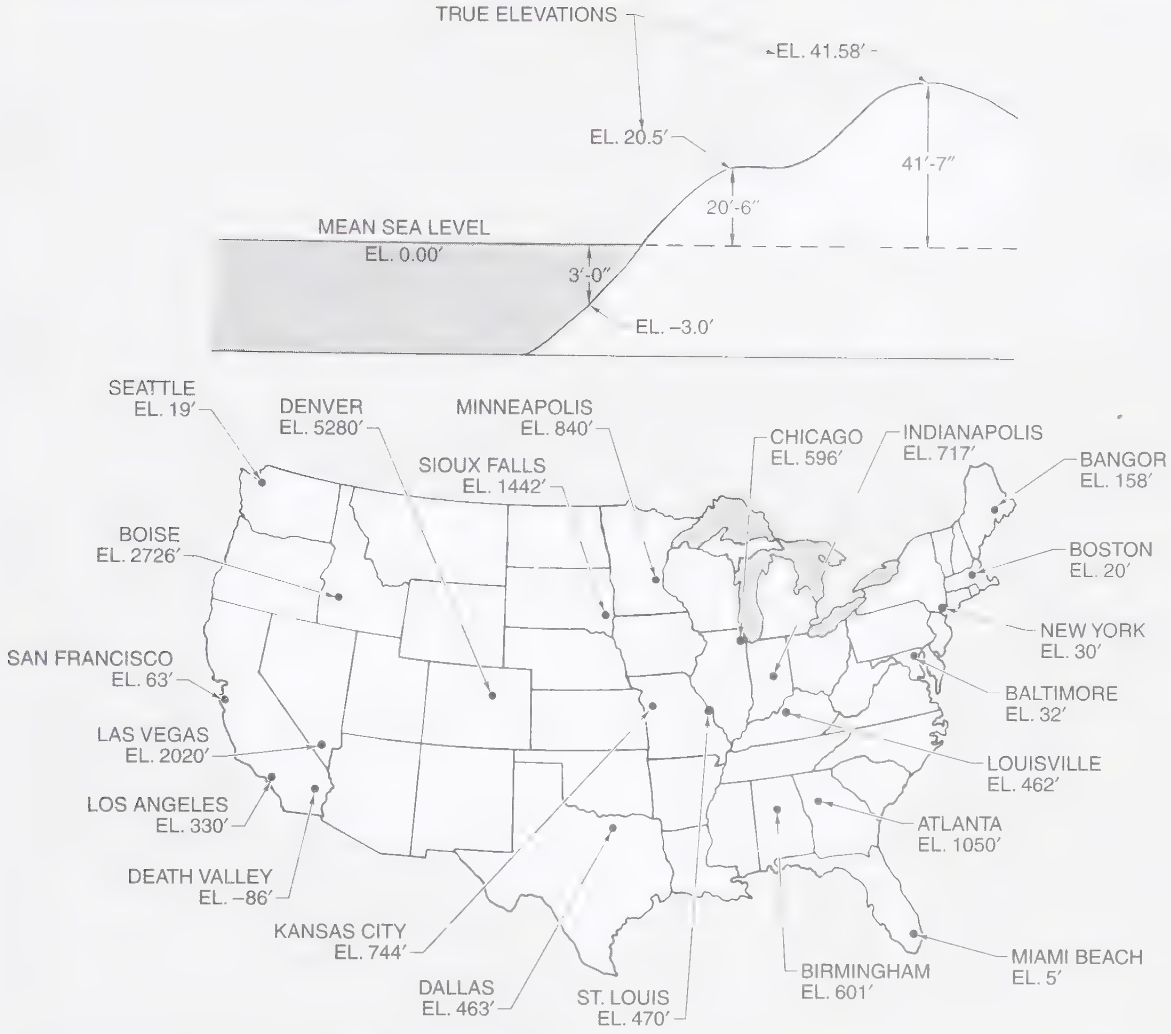


Figure 6-4. *Elevation refers to the height of an object above mean sea level or other reference point.*

Contour Lines

The natural grade and finish grade of a building lot are shown with contour lines. Contour lines on residential prints are straight or curved lines depending on the existing and desired finish slope of the lot. A dashed contour line represents the natural grade. A solid contour line represents the finish grade. Elevation dimensions for natural and finish contour lines are expressed as feet and tenths and hundredths of a foot. The elevation dimensions relate to the benchmark elevation indicated on the plot plan. Contour lines are shown at equal height intervals, such as 1′, 2′, or another equal elevation interval determined by the architect. As the steepness of the slope of the lot increases, the contour lines appear closer together on the plot plan. Where the ground is flatter, the contour lines are spaced farther apart.

Contour lines on plot plans indicate the natural and finish grades of a building lot

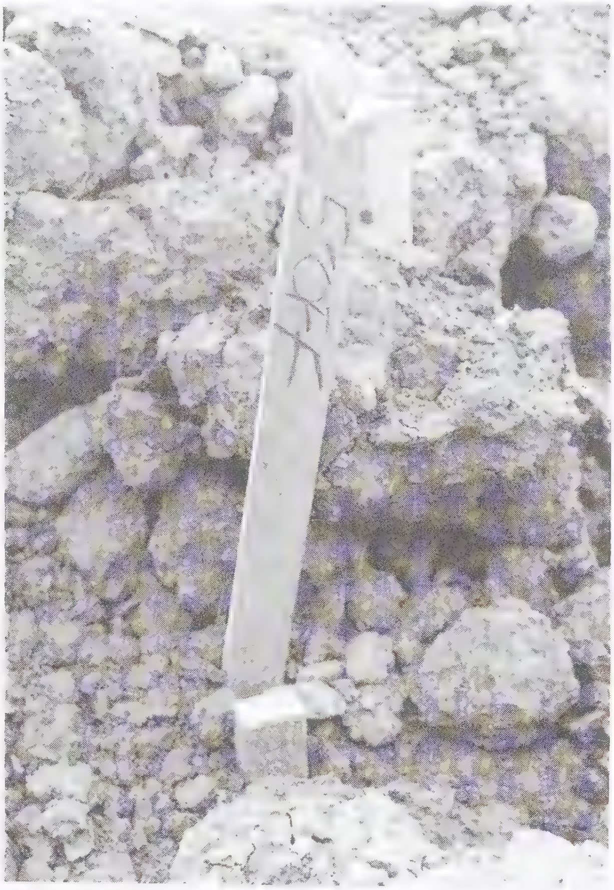


Figure 6-5. A benchmark serves as an elevation reference for a house.

Natural Grade. Elevation readings are taken at regular intervals on a building lot using a laser level or transit-level. The readings are recorded and plotted, and dashed contour lines showing the natural grade of the building lot are added.

In addition to the natural grade, existing landscaping features, such as trees and bushes, may also be noted on a plot plan. Architectural notations may be included on a plot plan indicating the trees that will remain after construction and those that will be removed.

Finish Grade. Elevations are provided along solid contour lines to indicate the grade of the lot at the completion of construction. Finish grades are designed by the architect to create a pleasing appearance and to allow stormwater to properly drain away from the house and into new or existing drainage systems. Where the ground is sloping toward a house, a swale (small depression) is constructed to provide for proper drainage. A swale is noted on a plot plan with small arrows in the swale pointing toward the stormwater flow direction.

BUILDING LOCATION

The location of a house on a building lot is determined by the architect within the requirements of the local building code. See Figure 6-6. A minimum distance, known as a front setback, is noted in the local building code. The front setback is the minimum distance that must be maintained between the front of the house and property line or the edge of the street. Minimum side and back setbacks may also be indicated in the local building code. The building location as shown on the plot plan must be in accordance with the setback dimensions before a building permit or occupancy permit is issued.

Per Section R302 (Location on Lot) of the International Residential Code, *exterior walls of a house with a fire separation distance less than 3′-0″ must have a minimum of one-hour fire-resistive rating. The fire separation distance is the distance measured from the face of the house to the closest interior property line, to the centerline of an alley, street, or other public thoroughfare, or to an imaginary line between two buildings on the property. The distance is measured perpendicular to the property line.*

Dimensions

The outline of the house is shown on the plot plan with object lines. Horizontal dimensions for the house location are measured from the property lines. Dimensions are expressed as feet and inches. The overall dimensions of the house may also be provided.

In addition to location dimensions and overall house dimensions, the sizes of garages, sheds, driveways, sidewalks, and patios are indicated on the plot plan. Dimensions for other building features, such as retaining walls, swimming pools, or fences are also located on the plot plan.

Building Elevations

The elevation of the first floor or the basement floor of a house is indicated on the plot plan. The elevation is typically shown within the house outline and is expressed as feet, tenths, and hundredths of a foot. The elevation is related to the benchmark and all other elevation dimensions on the plot plan. Elevations and the direction of slope for sidewalks and driveways are also shown.

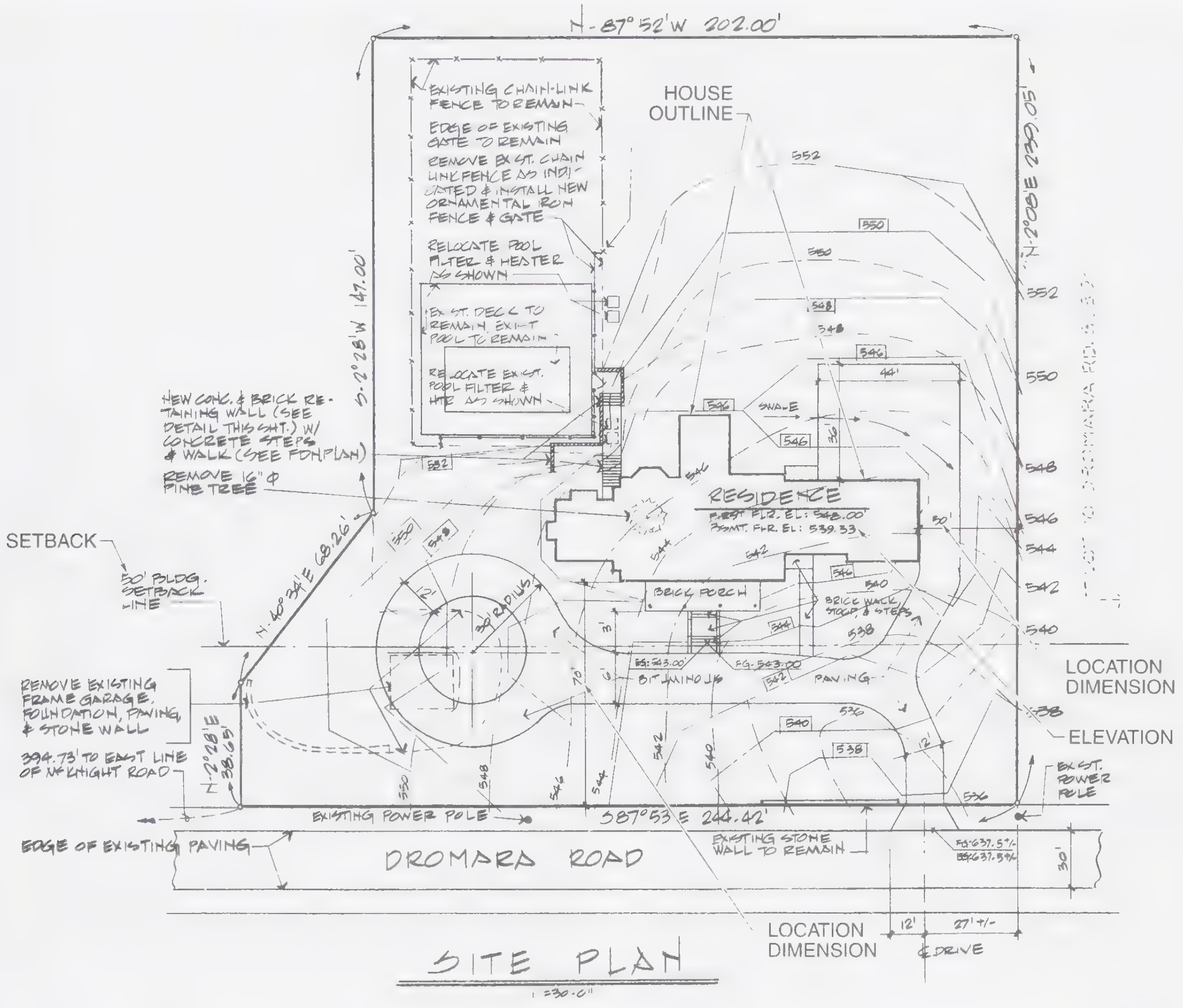


Figure 6-6. The location of the house on the lot is indicated with dimension lines extending from the property lines.

Excavation

Using the location and elevation dimensions on the plot plan, stakes are driven at the proper locations on the building lot to mark the house corners. See Figure 6-7. Some stakes are driven at the exact locations of building corners while other stakes are offset 2′ to 3′ from the corners. Offset stakes are driven in both directions away from the house corner to allow for excavation of the building without disturbing the location of the stakes. Horizontal boards, known as batterboards, may be attached to stakes and marked with reference points. Location and elevation dimensions determined from the point of beginning or the benchmark are marked on the offset stakes or batterboards. If piers are used, centerlines are marked with stakes to indicate proper placement.

Excavation is performed based on the elevations marked on the offset stakes and batterboards. See Figure 6-8. The common unit of measure for expressing the volume of excavated material is the cubic yard (cu yd). One cubic yard constitutes a space that is 3′ high, 3′ long, and 3′ deep. One cubic yard contains 27 cu ft (cubic feet). A plot plan indicates the natural grade of the lot, the finish grade, and the floor elevation of the house. These dimensions, along with information about the type of footing and foundation shown on the foundation plan, are used to calculate the volume of dirt to be removed.

When excavating for a full-basement foundation, the topsoil is removed from the area of the house. The excavated topsoil is mounded in a pile away from other soil. As the basement is excavated, the other soil is scattered as needed or hauled away.

Figure 6-7. The location of the house on the building lot is marked with corner stakes.

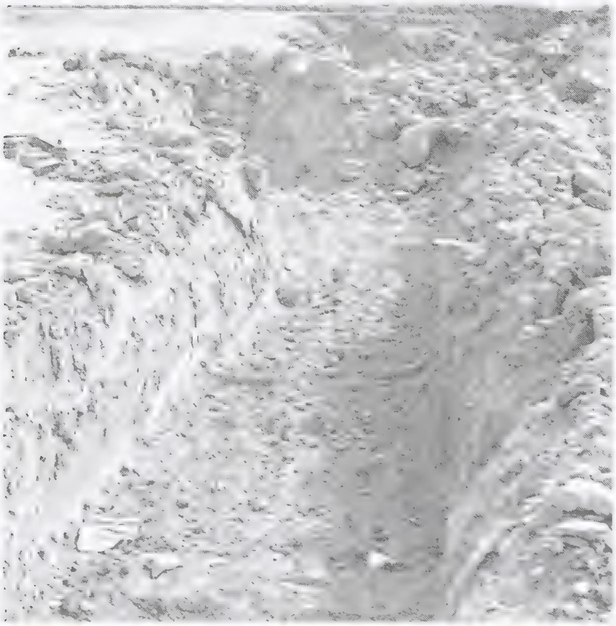


Figure 6-8. Excavation for the foundation is based on information noted on the offset stakes and batterboards.

As excavation proceeds, soil is placed at locations around the job site so as not to impede access of material delivery trucks. Where a cast-in-place concrete foundation is to be constructed, excavation and soil placement is done in a manner that allows ready-mix concrete trucks access to the excavation and sufficient height to reach the top of the basement wall forms for concrete placement. See Figure 6-9. Additional excavation, or overdig, allows room for tradesworkers to easily access the outside of the foundation walls.

Figure 6-9. Special excavation provisions are made for houses with basements, including accessibility for material delivery trucks and areas for tradesworkers to construct foundation walls.

After the foundation construction is completed and the foundation walls are properly braced, the topsoil that is mounded separately is placed around the house. Soil excavated from deeper in the earth does not have the same composition as topsoil and may have difficulty supporting plant growth.

The three basic geological classifications of soil are primitive, derived, and decayed. Primitive soil is formed from the direct decomposition of rock by chemical action or physical movement. Derived soil is created from the interaction of primitive soil with water and air. Decayed soil is primitive and derived soil mixed with decayed organic matter.

The depth of each soil type at the building site is determined by test boring. Holes are drilled into the earth, and the depth of each soil type is measured. The

depth of decayed soil, which is topsoil, varies with the geographic location. The load-bearing capacities of the lower levels of soil are computed to determine the type of foundation needed to support the house. On building lots where test boring indicates a rock base, blasting of the excavation area is required to meet the designed grade for footing and foundation placement.

Materials

The materials used to construct driveways, sidewalks, and patios are noted on the plot plan. Concrete, asphalt (bituminous) materials, brick, gravel, and solid concrete masonry units are common paving materials. Notations regarding the materials to be used for fences or retaining walls may also appear on the plot plan.

Driveways for passenger cars are typically 4″ thick. Most one-car driveways are 8′ to 12′ wide, and two-car driveways are 15′ to 20′ wide.

UTILITY LOCATIONS

The availability of utility services depends on the location of the building lot. Utility services may be more readily available in urban areas than in rural areas. The utility services available and their nearest locations are shown on the plot plan. Utilities include electric, natural gas, water, and sanitary and storm sewers. The plot plan also shows required easements for these utilities.

Electric

A plot plan shows the location of the electrical transformer nearest the house. Transformers reduce high electrical voltage to a lower, usable voltage. Standard voltages that transformers provide for residential electric service are 120/240 V (volt). Transformers can be located on the ground to provide lateral (underground) service or mounted on a pole to provide overhead service. See Figure 6-10.

Service cables extend from the transformer, through the electric meter, and to the service panelboard in the house. Electric service enters a house through lateral or overhead service. The service cables are heavily insulated to prevent weather damage to the electric service.

Electric service is provided by the local electric power company. A meter is installed and electric service is connected to the house after the required electrical inspections have been completed.

Many cities and states require that electrical wiring conform to provisions of the National Electrical Code® (NEC®). The NEC® is sponsored by the National Fire Protection Association (NFPA) and is revised every three years. NEC® revision is performed by committees comprised of representatives from various segments of the electrical industry, including inspectors, manufacturers, and contractors. The NEC® is approved by the American National Standards Institute (ANSI). Both the NFPA and ANSI consider the NEC® as advisory. An architect or contractor must contact the permitting authority having jurisdiction in the building area for the applicable information about electrical requirements in a given location.

Gas

Natural gas is distributed through underground galvanized cast iron or steel pipe or flexible polyethylene pipe. See Figure 6-11. Gas pipes are buried deep enough to resist movement of the ground caused by temperature changes. The location of the nearest gas main is shown on the plot plan.

A gas utility company runs pipe from the natural gas main near the street to the house after gas pipe installation in the house is completed and has passed inspection. A meter is attached to the house to measure the volume of gas consumed (in cu ft).

Where natural gas service is not available or another type of gas service is desired for the house, aboveground tanks may be installed and pipe extended to the house. The tank is placed near the house and refilled as needed.

Water service pipe is permitted to be installed in the same trench as the building sewer. The building sewer is installed at the base of the trench and the water service will be installed along the ledge at the right.

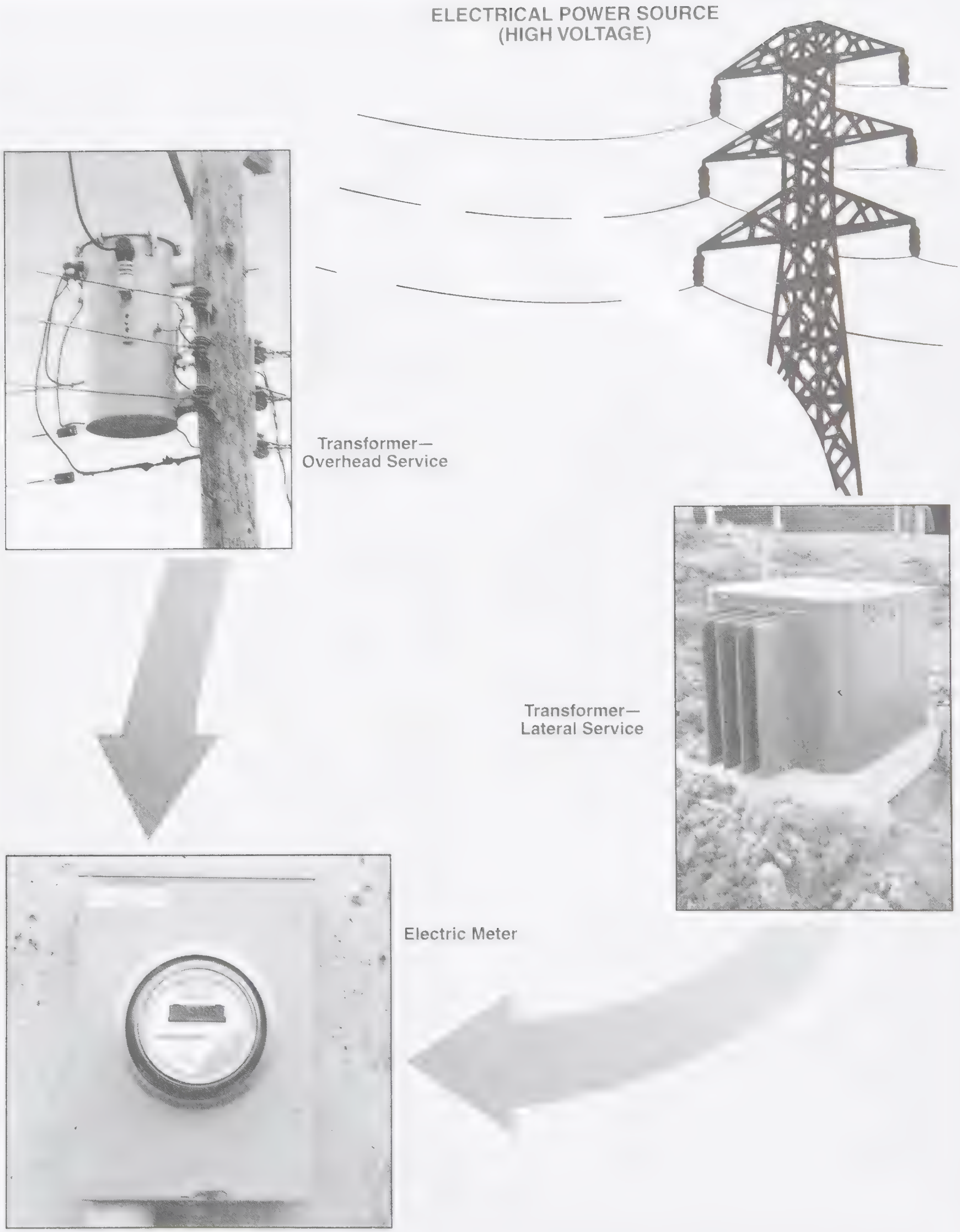


Figure 6-10 An electrical source provides high-voltage power to a transformer, which reduces the power to lower, usable voltages.

TRENCHING FOR UNDERGROUND PIPE

INSTALLING FITTINGS

GAS METER

PIPE FITTINGS TO EQUIPMENT

Figure 6-11. Natural gas is conveyed to a house through underground [illegible]

Water

In urban areas, large water supply pipes known as water mains are typically installed belowground along the edge of the street adjoining the building lot. The location of the nearest water main is shown on the plot plan. Water pipes are buried deep enough to avoid damage from freezing. See Figure 6-12.

Water supply pipes for residential construction are copper or polyvinyl chloride (PVC). Copper and PVC do not corrode easily, thereby protecting the quality of the water supply. The local water utility company is responsible for providing the water service between the water main and house. A water meter is installed in the water service immediately inside the wall of the house. A water meter measures the water usage (in gallons) of the occupants of the house. A remote register is typically installed outside the house after the exterior wall finish is applied.

In rural areas where municipal water service is not available, wells are drilled that tap the groundwater below the building lot. The well depth depends on the elevation of the water table beneath the lot. Some wells are several hundred feet deep. An electric pump is attached to the drilled well pipe to bring water to the surface and into the house, where the water is treated for impurities prior to use.

Figure 6-12. In urban areas, water mains provide water for residential use.

Sewer/Septic Field

Urban areas have two types of drainage systems—stormwater drainage systems and sanitary drainage systems. Stormwater drainage systems convey rainwater and other surface water to lakes, rivers, and other outlets for disposal. Catch basins along street curbs are the most common method of collecting rainwater and other surface water into stormwater drainage systems.

Sanitary drainage systems convey wastewater and waterborne waste that requires treatment. Wastewater and waterborne waste are discarded from plumbing fixtures such as water closets, sinks, and lavatories. Sanitary drainage systems are constructed of heavy PVC, acrylonitrile-butadiene-styrene (ABS), or copper pipe and fittings. In a residential subdivision, sanitary drainage pipes are installed before other utilities. The elevations of the sanitary drainage pipes are designed to create a downward flow from the house to the sanitary sewer. Sanitary sewer locations are shown on a plot plan. A building sewer pipe extends from the house to the sanitary sewer. A backwater valve may be installed along the building sewer pipe to prevent wastewater from the sanitary sewer from entering the house.

Where older sewer systems exist, a combined sewer system may be encountered. A combined sewer system handles both stormwater and wastewater. Combined sewer systems are more expensive for a municipality, as the volume of water requiring treatment is higher than separate stormwater and sanitary drainage systems.

In rural areas or areas where sanitary sewer service is not available, an absorption field, also known as a septic field, is used to dissipate wastewater and waterborne waste. See Figure 6-13. Chemicals and bacteria are kept in a sealed tank known as a septic tank. Raw wastewater and waterborne waste enters the septic tank where harmful wastes are broken down through bacterial action. Wastewater flowing through the septic tank carries tiny waste particles through the distribution box and into the buried grid of perforated pipes. The perforations allow the wastewater and particles to seep into the soil. The area around the perforated pipes is the absorption field. The location of the septic tank, distribution tank, and absorption field may be shown on the plot plan.

A percolation test is required before installing a septic system. Percolation tests are used to determine the percolation rate, which is the rate at which the soil will absorb liquid.

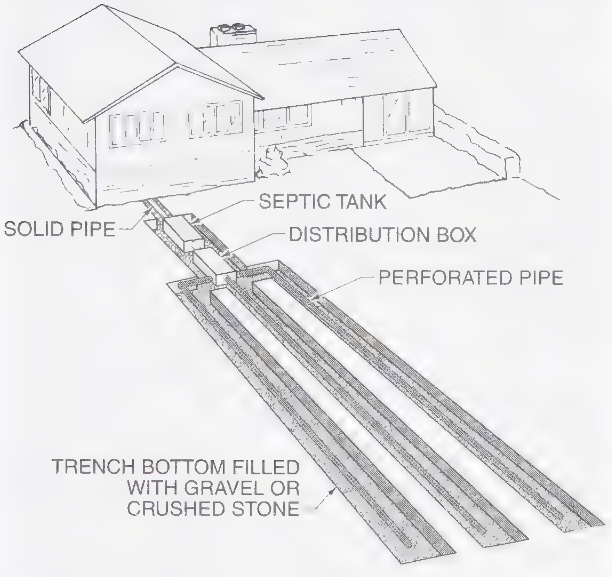
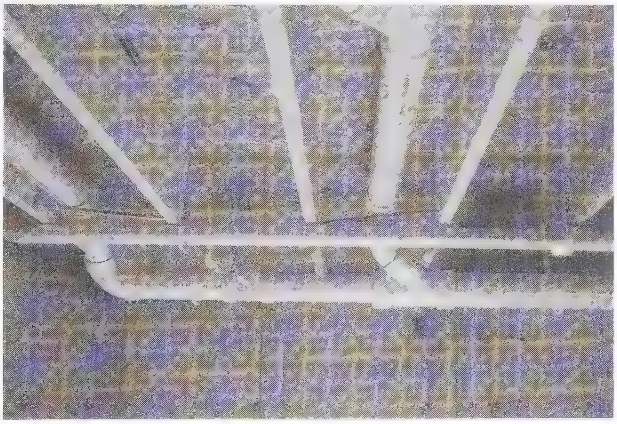


Figure 6-13. Sanitary sewers or septic tanks and absorption fields safely dispose of wastewater and waterborne waste.



Sanitary drainage pipes must be installed with a small amount of slope so wastewater and waterborne waste flows toward the sanitary sewer or septic tank.

Easements

An easement is a strip of land, commonly along the perimeter of property lines, that is used for placement of utilities. The sizes and locations of easements are noted on plot plans. An easement is commonly a strip of land along one edge of the property varying from 4′ to 10′ wide. Utility services are placed in an easement when possible. Easements are typically located at the street line, at the rear of the property, or between building lots. In some areas where building lots may block access to adjoining properties, easements may be provided for access roads.

Septic systems must be properly located on a building site to ensure that wastewater and waterborne waste does not enter the water supply, which is typically a well in rural areas.

ABBREVIATIONS AND SYMBOLS

Abbreviations describing compass directions, elevations, materials, and utilities appear on plot plans. Symbols and various types of lines show grading and utility placement. Both abbreviations and symbols conserve space on plot plans.

Abbreviations

Abbreviations on residential plot plans indicate the four compass directions. See Figure 6-14. Elevations of natural and finish grade are also abbreviated. The types of materials used for driveways, sidewalks, retaining walls, and fences are indicated with abbreviations. Utility services may also be abbreviated. An abbreviation of a letter along a utility service line indicates the purpose of the lines. For example, a "G" indicates a natural gas pipeline. In some instances, one abbreviation indicates two different items. For example, "V" is the abbreviation for valve and volt.

Symbols

Symbols on plot plans show the natural and finish grade of the building lot. **See Figure 6-15.** Existing trees are shown with symbols. Bushes, trees to be planted, and other landscaping are indicated on the plot plan with symbols. Utility service lines, electrical transformers, and plumbing pipes are also shown with symbols.

OTHER REFERENCES

Information included on other sheets of the prints may be related to the property lines and building layout. The foundation plan provides dimensions needed to calculate the amount of excavation required. Elevations contain information about basement depth, and driveway, sidewalk, and patio materials. The specifications provide information about the general conditions for grading of the lot and paving details.

PLOT PLAN ABBREVIATIONS			
Abbreviation	**Term**	**Abbreviation**	**Term**
A or AMP	Ampere	MDN	Median
ASPH	Asphalt	MER	Meridian
AVE	Avenue	MH	Manhole
BDRY	Boundary	MN	Main
BIT	Bituminous	N	North
BL	Building line	NG	Natural grade
BLDG or BL	Building	PERIM	Perimeter
BLVD	Boulevard	PLBG	Plumbing
BM	Benchmark	POB	Point of beginning
CA	Cable	PP	Piping
CB	Catch basin	PT	Point
CJ	Control joint	PVC	Polyvinyl chloride
CO	County	PWR	Power
COR	Corner	R	Range
CPR or COP	Copper	RD	Road
CTR	Contour	RETG	Retaining
CU FT	Cubic foot	S	South
CU YD	Cubic yard	SAN	Sanitary
DIR	Direction	SERV or SVCE	Service
DR	Drain	SEW	Sewer
E	East	SPLY	Supply
ELEC	Electric or electrical	STR	Street
EXC	Excavate	T	Township
EXST	Existing	TD	Tile drain
FG	Finish grade	TEL	Telephone
G	Gas	TV	Television
GAR	Garage	UGND	Underground
GL	Grade line	V	Valve
GR	Grade	V	Volt
GRD	Ground	W or WTR	Water
GVL	Gravel	W	Watt
HPT	High point	W	West
HWY	Highway	WL	Water line
LCL	Local	YD	Yard
LP	Low point		

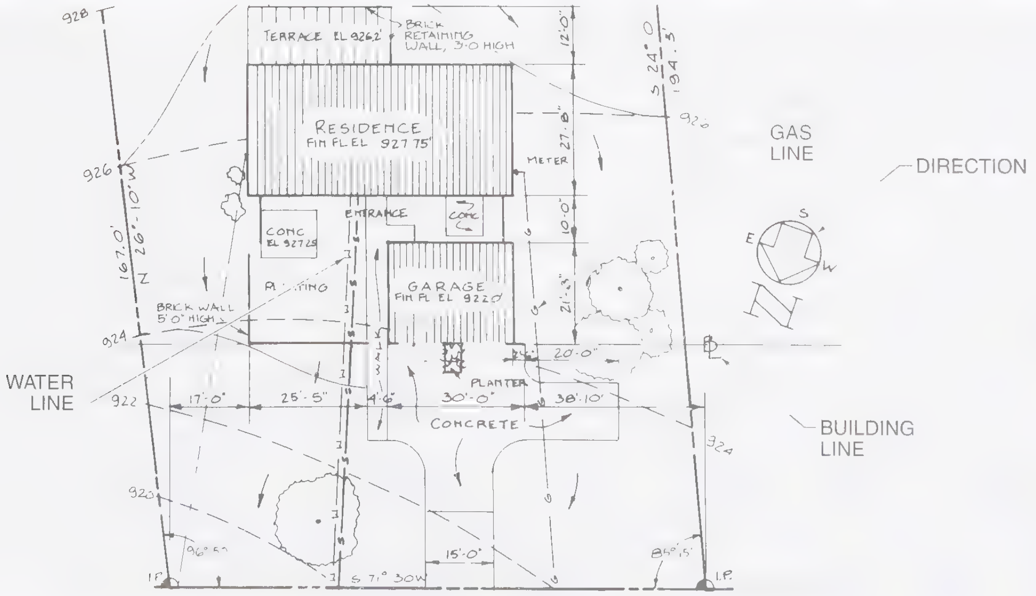


Figure 6-14. Directions, locations, and utility services are shown on plot plans with abbreviations.

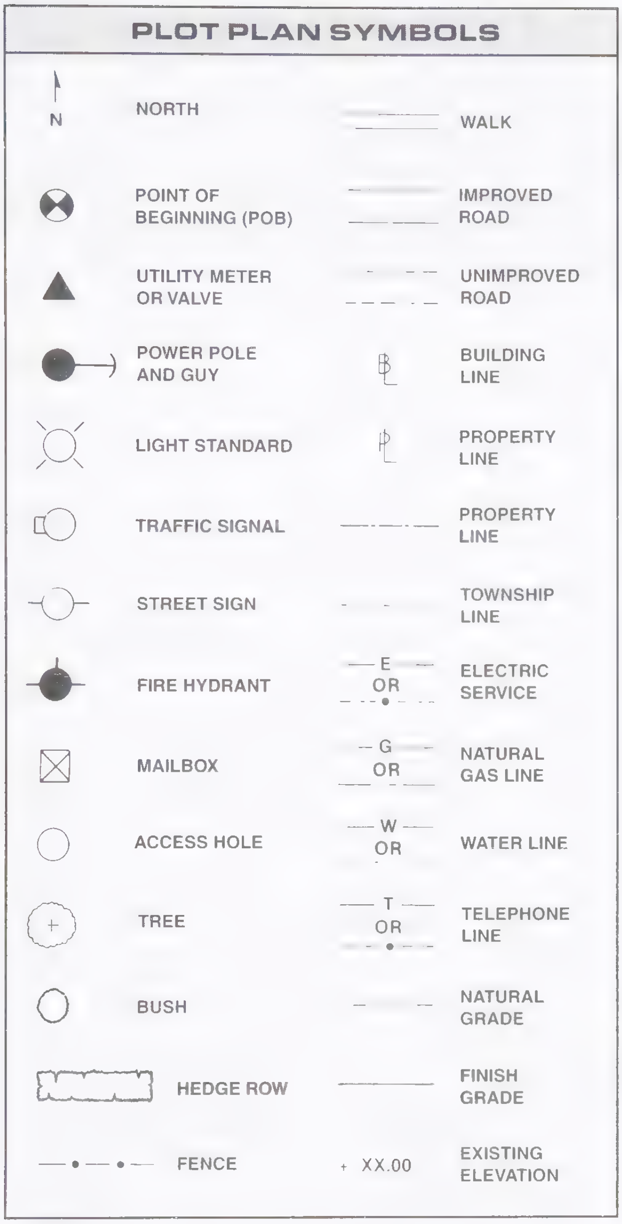


Figure 6-15. *Plot plan symbols represent utilities, construction materials, and landscaping.*

Foundation Plans

The foundation plan is the primary source of information about the type of foundation for the house. Elevation dimensions shown on the plot plan are related to the type of foundation shown on the foundation plan. Placement of layout stakes and batterboards and excavation requirements are based on the foundation type shown on the foundation plan.

The amount of excavation required for a foundation is determined from elevation dimensions shown on the plot plan, foundation plan, and exterior elevations.

Elevations

For houses with basements, the foundation is shown on exterior elevations with hidden lines showing the depth and height of basement walls and footings. The elevation dimensions included on exterior elevations are used in conjunction with elevation dimensions shown on the plot plan and information on the foundation plan to determine the necessary excavation. The first floor elevation dimension may also appear on the exterior elevations.

Elevations also provide additional information about the materials for construction of driveways, sidewalks, and patios. Fences and retaining wall materials, finishes, heights, and lengths may also appear on elevations.

Specifications

The specifications may provide specific information about excavation methods to be used for placement of topsoil and finish grading of the lot. The topsoil may be placed at a specific location for later use or graded as part of the finish grading. The finish of the building lot may also be noted in the specifications. Information related to landscaping allowances and guarantees may also be included in the specifications. See Figure 6-16.

Depending on composition, the weight of topsoil ranges from 76 lb/sq ft to 115 lb/sq ft.

19. ROOFING

Apply 235# three tab asphalt roof shingles over 15# felt.

20. SEEDING AND FINISH GRADING

Upon completion the area of the lots will be final graded, seeded, fertilized and strawed. It is to be understood that watering the new seed is the sole responsibility of the purchaser.

LOT INFORMATION

21. SCREENS

All windows to receive full hanging aluminum framed screens with charcoal vinyl screen cloth.

22. STEEL SASH

All basement windows to be ventilated steel sash and to receive metal framed screen with fiberglass screen cloth.

23. TILEWORK

All bathrooms to receive tile floors and walls to the extent indicated on drawings, with chrome accessories. Kitchen to receive tile to extend from top of sink to bottom of upper cabinets in work area. The owner will have a choice of color selections as shown in Sales Office.

24. GENERAL CONDITIONS

The intent of the above specifications is to indicate the various materials, equipment and work to be installed in the building under this sales contract. This specification is intended to tell you what you are to receive in the completed construction of your new home. At the time that your home is completed, and just prior to your

Figure 6-16. Specifications may provide additional information for use with plot plans.

REVIEW QUESTIONS

CHAPTER 6

Plot Plans

Name ______________________ Date ____________

True-False

T F 1. A township is 36 miles long on each side.

T F 2. Ranges run in an east-west direction.

T F 3. An arrow indicating north appears on plot plans.

T F 4. The most common drawing scale for a plot plan is ¼″ = 1′-0″.

T F 5. The length of property lines is expressed in feet and inches or feet and tenths and hundredths of a foot.

T F 6. Elevation 45.67′ is higher than elevation 35.78′.

T F 7. A benchmark is referenced to help in the calculation and layout of elevations.

T F 8. Contour lines are spaced further apart as the slope of the ground becomes steeper.

T F 9. Symbols on a plot plan show existing landscaping.

T F 10. Materials used to construct driveways, sidewalks, and fences are shown on a plot plan.

T F 11. Offset stakes allow for excavation without disturbing the layout points.

T F 12. Construction materials are not noted on the plot plan.

T F 13. Transformers reduce high voltages to 120 V for residential consumption.

T F 14. Water mains are constructed of cast iron.

T F 15. A backwater valve is installed on the electric meter.

T F 16. Chemicals and bacteria in septic tanks are used to treat raw wastewater and waterborne waste.

Multiple Choice

_______________ 1. The north-south geographic dividing lines are ___.
A. meridians
B. baselines
C. benchmarks
D. ranges

_______________ 2. A point of beginning (POB) is located at ___.
A. each building lot corner
B. quarter section corners
C. range intersections
D. easements

_______________ 3. ___ does not appear on a plot plan.
A. Compass direction
B. A property line
C. The name of the street
D. The distance from the house to nearest adjacent house

_______________ 4. Which of the following angles is correct for a plot plan property line?
A. E 65°-12′ N
B. N 98°-45′ E
C. S 57°-18′ W
D. W 16°-57′ S

_______________ 5. The height of an object above sea level or a specified benchmark is its ___.
A. length
B. dimension
C. location
D. elevation

_______________ 6. Dashed contour lines indicate the ___.
A. location of the property lines
B. finish grade
C. natural grade
D. house location on the building lot

_______________ 7. A setback is the ___.
A. distance from the garage to the house
B. outline of the house on the plot plan
C. minimum distance from the property line to the house
D. same as the property line

_______________ 8. Elevations are expressed as ___.
A. feet and tenths and hundredths of a foot
B. feet and inches
C. degrees and minutes
D. none of the above

_______________ 9. The overdig for the foundation allows for ___.
A. material deliveries
B. access to the outside of foundation walls
C. access to the inside of basement walls
D. accurate location of a benchmark

10. A basic geological classification of soil is ____.
   A. primitive
   B. decayed
   C. derived
   D. all of the above

Completion

1. A township four rows south of the baseline and six columns east of the meridian is abbreviated as ____.
2. Forty-five degrees, eighteen minutes east of south is written as ____.
3. There are ____ scales on an engineer's scale.
4. The elevation of mean sea level is ____.
5. A stable object used as a constant reference point for determining elevation is a(n) ____.
6. A(n) ____ is a small depression to allow for drainage of surface water.
7. ____ soil is formed from the direct decomposition of rock by chemical action or physical movement.
8. One cubic yard contains ____ cu ft.
9. Three materials used for gas pipe are ____, ____, and ____.
10. Catch basins collect rainwater for ____ drainage systems.
11. A(n) ____ is a strip of land, commonly along the perimeter of property lines, that is used for placement of utilities.

Activities

Measure the following lines with an engineer's scale using the scale indicated.

1. 1″ = 40′-0″
2. 1″ = 60′-0″
3. 1″ = 20′-0″
4. 1″ = 30′-0″
5. 1″ = 50′-0″
6. 1″ = 10′-0″

Printreading

Refer to the plot plan on page 109 for questions 1 through 21.

T F 1. The driveway is asphalt.

T F 2. The sewer, water, and gas lines are installed in the same trench.

T F 3. The point of beginning does not appear on this drawing.

T F 4. The front planting area is hidden by a concrete wall.

T F 5. Finish grade is lower than natural grade at the terrace.

T F 6. Electric service is on the rear south corner of the building lot.

______ 7. In relation to the house floor, the garage floor is ___.
- A. lower
- B. higher
- C. at the same elevation
- D. no garage floor elevation is given

______ 8. The house entrance faces ___.
- A. north
- B. south
- C. east
- D. west

______ 9. The lot generally slopes down toward the ___.
- A. north
- B. south
- C. east
- D. west

______ 10. The meter on the west side of the house is for ___ service.
- A. electric
- B. gas
- C. water
- D. none of the above

______ 11. The elevation of the garage floor is ___′.

______ 12. The building line is ___ from the property line.

______ 13. The rear terrace projects ___ south of the house.

______ 14. The distance between the house and the garage is ___.

______ 15. The drawing scale is ___.

______ 16. The back property line is ___′ long.

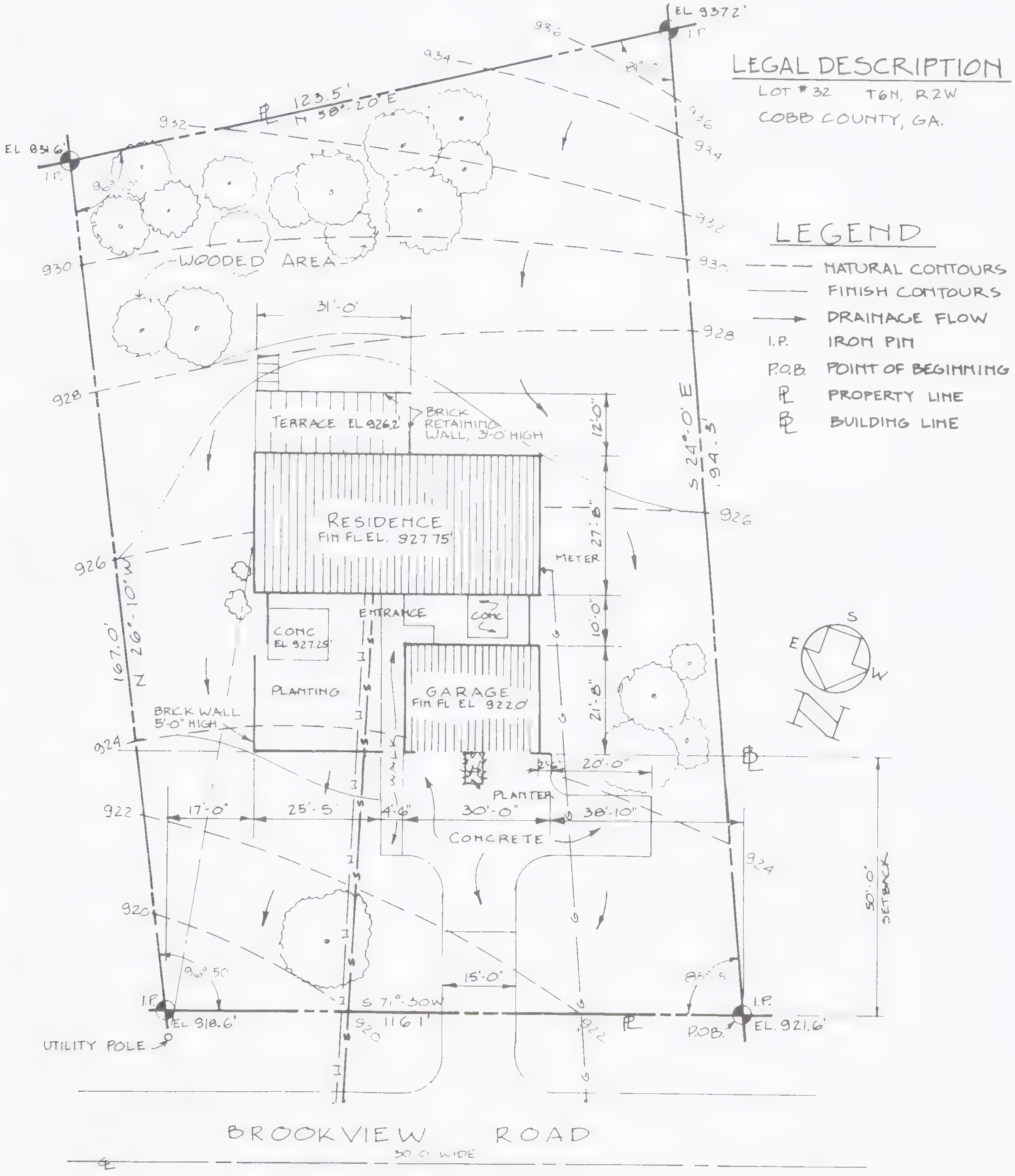
______ 17. The compass direction of the front property line (written out) is ___.

______ 18. The highest elevation of the four property corners is ___′.

______ 19. The smallest angle at the intersections of the property lines is ___.

______ 20. The lot is located in range ___.

_________________ **21.** The difference in elevation between the highest property line corner and the lowest property line corner is ___′.



PLOT PLAN

SCALE: 1″ = 20′-0″

Identification

Identify the geographic divisions.

_______________ **1.** 1 mile

_______________ **2.** Quarter section

_______________ **3.** Meridian

_______________ **4.** 6 miles

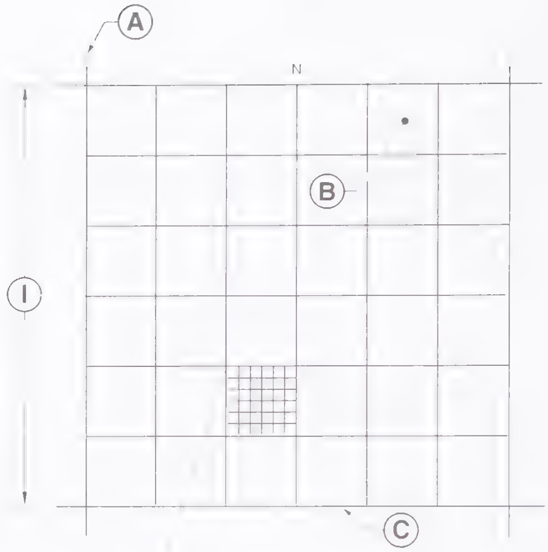
_______________ **5.** Point of beginning

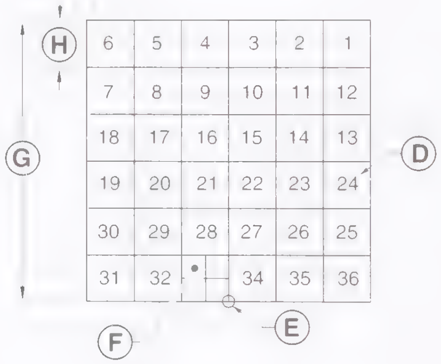
_______________ **6.** 36 miles

_______________ **7.** Township

_______________ **8.** Baseline

_______________ **9.** Section





Foundation Plans

> *While the layout and excavation of a building site are the first actions taken on the site, the foundation footings and walls are the first signs showing the shape and size of the house. Proper foundation design and construction is vital to the appearance and lasting quality of any building. Many different footing and foundation wall designs are used based upon the load to be supported and the load-bearing capacity of the soil. A foundation plan provides information about the type of footing and foundation wall required to support the house. The size of the foundation members and the materials to be used for its construction are shown.*

CUTTING PLANES

Architects show the foundation plan as a plan view. A plan view is a horizontal slice taken through a house showing the locations and sizes of walls and other items at or below the cutting plane. A plan view is also used for a floor plan.

Horizontal Slices

The cutting plane, or horizontal slice, for a foundation plan is located 5′-0″ above the basement floor level. See Figure 7-1. The foundation plan slice shows exterior foundation walls and interior columns, beams, and partitions to be constructed in the basement. The footings are not visible, and thus are shown with hidden lines.

If a house does not have a basement, a foundation plan shows locations for all supporting members with a cutting plane located at ground level. Footings, grade beams, foundation walls, columns, and other structures are shown with the same lines and symbols as for a house with a basement.

FOUNDATION FUNCTIONS

Foundations consist of footings and foundation walls. Footings and foundation walls serve many functions including structural support; creation of a level, straight, and square working surface; and a means for anchoring the house to a stable structure.

Structural Support

Footings and foundation walls support their own weight and the weight of the rest of the building. A building without a solid base will experience shifting and settling caused by external forces such as temperature changes, wind loads, and normal use. The external forces exert great stresses on a building.

An architect designs a foundation by taking into account all forces, stresses, and weights that act on the footing and foundation walls and the remainder of the building. Architects calculate the bearing capacities of different soil types, assess the structural integrity of various construction materials, and select from among the different designs used for footings and foundation walls to provide solid structural support.

Chapter 4 of the International Residential Code *provides information regarding foundations.*

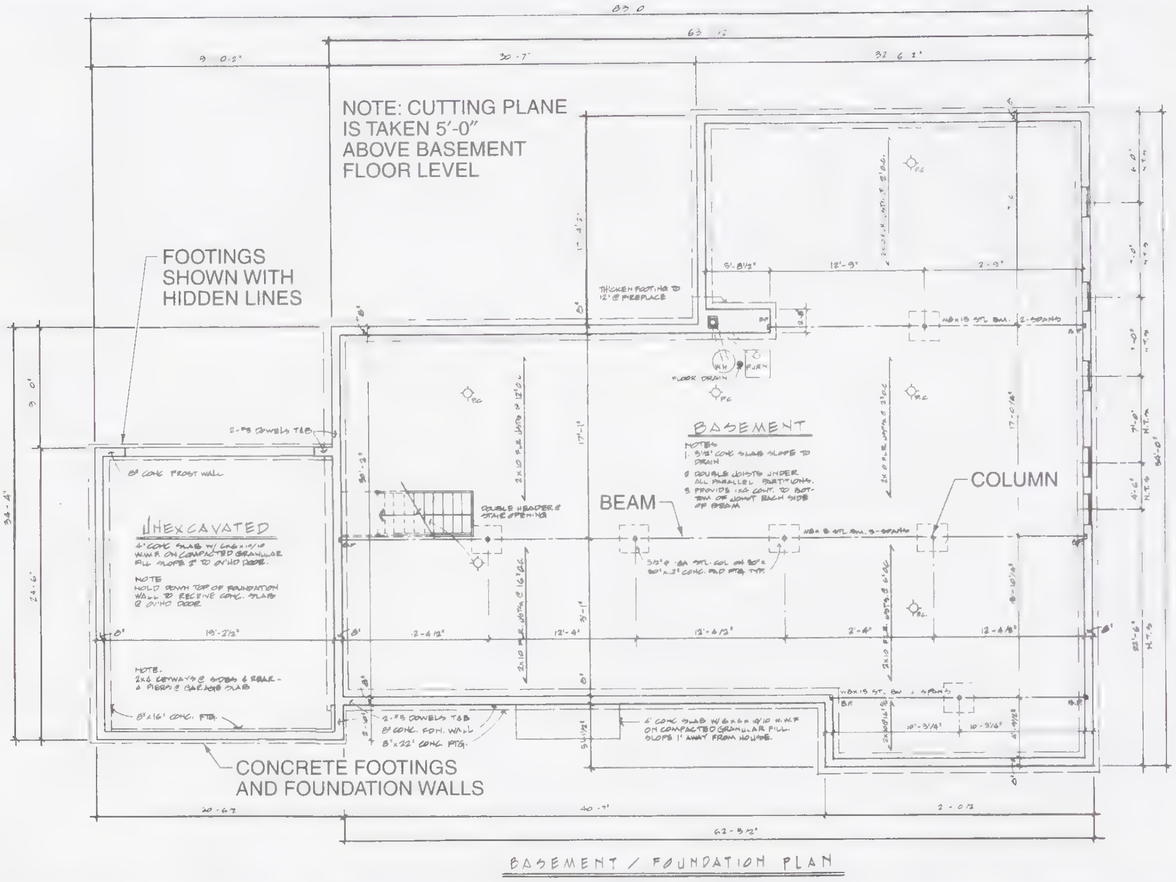


Figure 7-1. Foundation plans contain information about foundation footings and walls, columns, beams, and basement floor.

Working Surface

In order for a house to be completed successfully, each step of the construction process must be performed properly. A seemingly minor problem at the beginning of construction can become a major source of difficulty before the conclusion of the project. This is especially true in foundation construction. A foundation that conforms to the print dimensions and specifications is helpful to all the tradesworkers who construct the remainder of the building.

Level, Straight, and Square. A foundation built level, straight, square, and to the proper dimensions makes floor, wall, and roof framing easier. A manufactured house requires that a specific-sized foundation be constructed to fit the print dimensions. The setting of finish fixtures, such as cabinets, is made easier and the final product more attractive when the foundation is constructed accurately.

The top of the foundation wall is leveled with a transit-level, laser level, or builder's level. A string, laser level, or transit-level is used to ensure that all foundation walls are straight. Corners of the foundation wall are squared by measuring diagonals or using the 3-4-5 method of squaring. See Figure 7-2.

Anchoring. Proper anchoring must be provided at the top of the foundation for securing the structure above. In wood-framed residential construction, anchor bolts are set in the foundation. The anchor bolts are inserted in the fresh mortar or concrete with the threaded end projecting up out of the foundation. The lower end is offset or shaped like the letter "J" to provide better holding power. Residential anchor bolts are typically ½" in diameter and vary in length from 10" to 12". For permanent wood foundations, the footing plate and bottom plate are nailed together. For metal-framed residential construction, anchors bolts projecting from the foundation secure the metal framing members in position. In locations where anchor bolts cannot be inserted in concrete or mortar, drive pins from a powder-actuated tool are driven through the structural member and into the foundation.

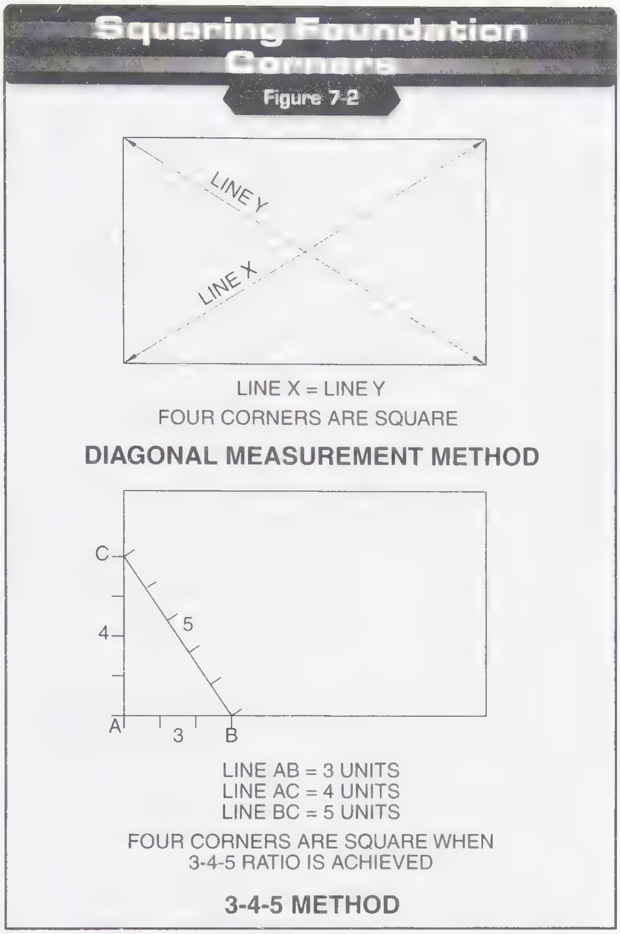


Figure 7-2. *Foundation corners are to be square, unless otherwise indicated on the foundation plan. Equal diagonal measurements or the 3-4-5 method ensure square corners.*

The design and anchoring requirements of a house are determined from the prints or specifications and must conform to the local building code. The *International Residential Code* requires that anchor bolts be spaced a maximum of 6′ OC, with a minimum of two bolts per plate section.

FOUNDATION SYSTEMS

A variety of foundation systems and materials are currently used in the construction field that vary widely in use and function. Regional availability of materials, job site accessibility, local building code requirements, and regional climate conditions account for the wide range of foundation types. New materials and innovative designs for foundations continually undergo development and testing.

Foam insulation panels are placed along the exterior face of foundation walls prior to backfilling around the foundation.

The most common foundation systems are the conventional concrete footings and foundation walls, the inverted-T system, insulated concrete form (ICF) systems, concrete slab-on-grade, concrete piers and grade beams, masonry, plywood, and piles. Familiarity with the various foundation systems helps tradesworkers visualize the intent of the architect and properly execute and implement the design into a construction project.

Conventional Concrete Foundation Footings and Walls

Cast-in-place concrete as a foundation material has gained acceptance throughout the construction industry. Cast-in-place concrete is the most common material used for foundation footings and walls. Concrete has exceptional strength, great durability, an attractive appearance, and is easily transported to the job site.

A good concrete mixture depends on good-quality ingredients and good weather conditions when placing the concrete. Concrete is strongest if the proper proportions of cement, aggregate, and water are maintained from mixing to placement. Excessive water thins and weakens the concrete mixture. Weather conditions are another key to successful concrete placement. Concrete strength is diminished if it is allowed to freeze before it hardens and sets. Concrete is kept warm during freezing conditions by placing straw or plastic sheets on top of the fresh concrete or leaving the concrete forms in place for an extended period of time prior to stripping the forms. These techniques help to retain the heat generated by hydration, a chemical reaction that occurs in the concrete.

Footings. The footings are the first part of a foundation to be placed. Low forms are set according to the layout stakes or batterboards that have been installed based on the plot plan dimensions. Footing forms are commonly made of 2 × 4s or 2 × 6s set on edge or of reusable metal forms. The top edge of the footing forms is set to a specific elevation, which is determined from the plot plan or foundation plan. Bracing with stakes, braces, and some of the excavated soil keeps the forms straight and rigid during concrete placement.

Footing sizes vary depending on soil conditions and the load to be supported. The most common size for a residential concrete footing is 20″ wide by 8″ deep. The architect specifies larger or smaller footing sizes as required to support the intended load.

Steel reinforcing bar (rebar) is set between the footing forms prior to concrete placement. Rebar improves the tensile strength of cured concrete. Rebar is available in a variety of diameters and lengths. Rebar is formed with small ridges that enhance its holding power in concrete. See Figure 7-3. The most common size rebar used in a residential footing is ½″ in diameter (#4 rebar) and 12′ long.

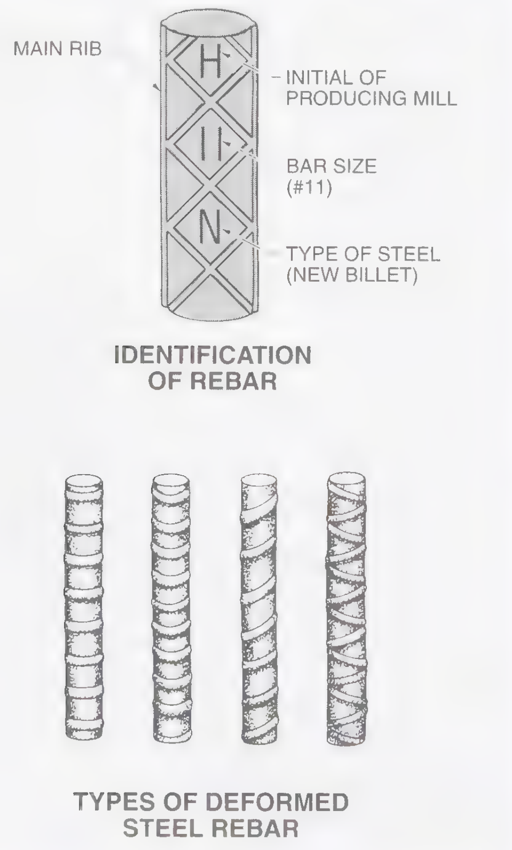


Figure 7-3. Rebar is placed in cast-in-place concrete footings and walls for additional strength. Rebar is sized by number, from ⅜″ to 2¼″ in diameter in ⅛″ increments.

A keyway is formed along the top of a footing to improve the joint between the footing and foundation wall and lock them together more securely. See Figure 7-4. A keyway is formed by dragging a piece of lumber lengthwise down the center of the partially set concrete, scoring it to a depth of several inches to provide an adequate locking groove.

A keyway can also be formed by securing chamfered 2 × 4s flat to the top of the footing forms before concrete is poured. The edges of the 2 × 4 keyway form are chamfered (cut at an angle) to allow for ease of removal after the concrete has set. Lumber expands as it absorbs moisture from the concrete. A square piece of lumber used to form a keyway will become locked into the concrete.

Footings must project a minimum of 2″ on each side of the foundation wall.

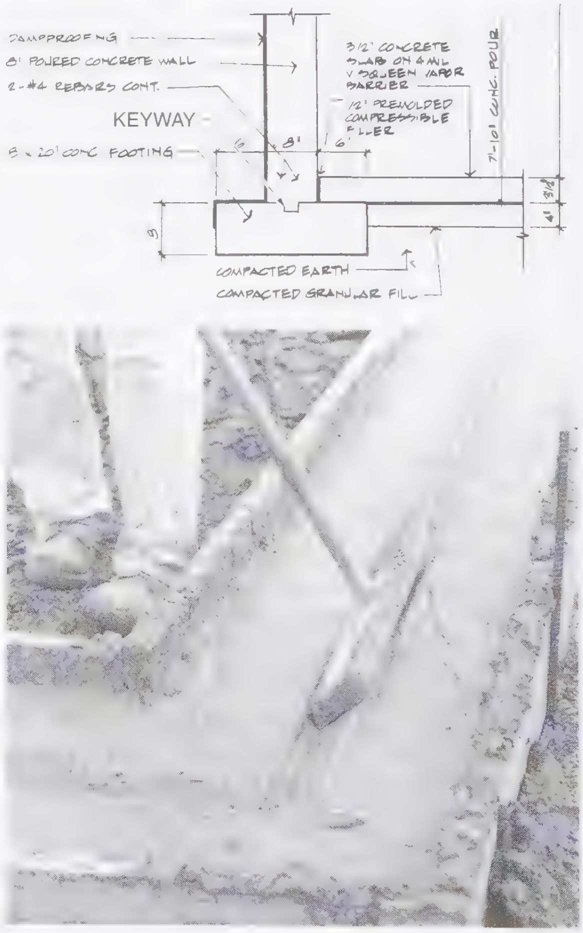


Figure 7-4. A keyway formed in a footing makes a better joint where a cast-in-place concrete footing and foundation wall are joined.

Footings must attain adequate strength before foundation wall construction can begin. Concrete placed for footings typically acquires enough strength overnight to begin placement of the foundation wall system the following day.

Foundation Walls. Residential concrete foundation walls are most commonly 8″ thick (unless otherwise specified) and of sufficient height to provide adequate headroom in the basement, usually 7′ to 8′. Due to the headroom provided, living areas and appliances such as water heaters, furnaces, washers, and dryers can be located in a basement.

Many forming systems are available to construct residential concrete foundation walls. Most forming systems consist of prefabricated panels that are joined using a variety of methods. See Figure 7-5. One type of forming system is constructed of plywood panels that lock together using swivel clips and pins attached to the back of the panels. Other forming systems use plywood or metal panels with metal frames that are joined together by inserting slotted wedges through slots in the frames. All prefabricated forming systems provide forms of many sizes for fabrication of any wall dimension desired. Forms may also be constructed with 4′ × 8′ plywood panels framed with 2 × 4s. All-wood forms are nailed together and cut to size for various wall lengths. All wall forming systems, whether prefabricated or job-built, use metal form ties to hold the two sides of the wall forms at a uniform distance and provide more strength for the forms.

Wing walls and pilasters may be constructed as part of the wall forms to provide additional strength. Wing walls are triangular-shaped projections, typically 3′-0″ long by 3′-0″ deep, constructed on the outside of the foundation wall. The wings are constructed toward the top of the foundation wall and are typically used to provide additional horizontal support for porches and slabs adjacent to the house.

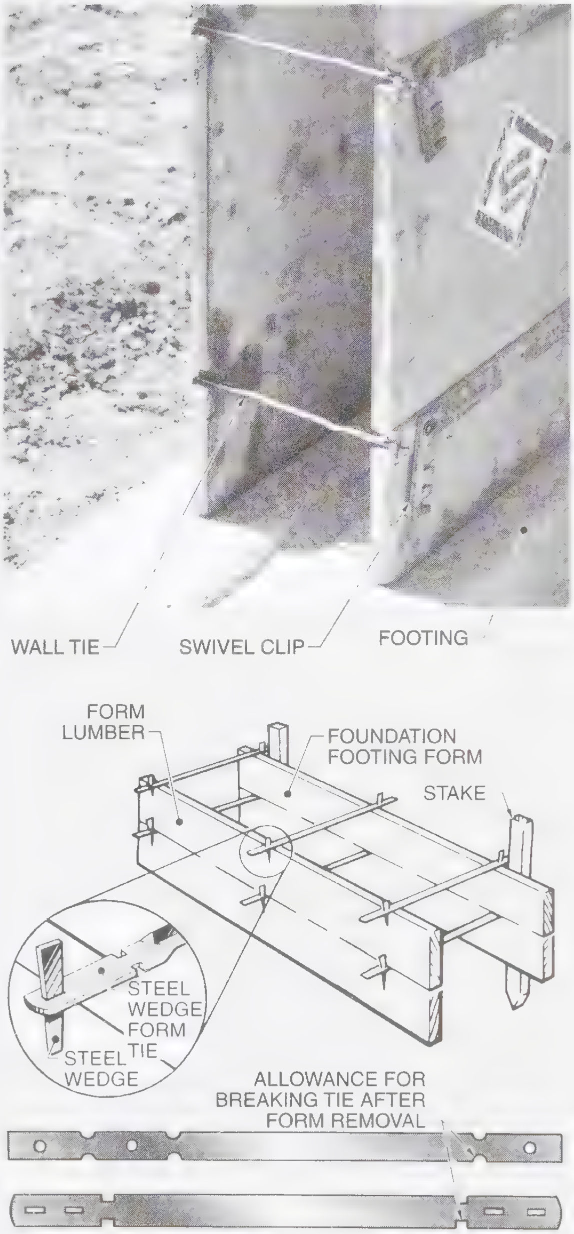


Figure 7-5. Prefabricated or job-built forms may be used to form a residential foundation. Metal form ties secure the foundation wall forms together.

Per the International Residential Code, *backfill must not be placed against foundation walls until the walls have sufficient strength and are properly anchored to the floor above or until the walls have been adequately braced to resist the lateral pressure exerted by the backfill. However, bracing is not required for foundation walls supporting less than 4′ of backfill.*

Pilasters are rectangular projections that extend the full height of a foundation wall along the inside of the wall. Pilasters typically project 1′-0″ to 2′-0″ into the basement. Pilasters provide the lateral strength needed for long, straight foundation walls to resist soil pressure. Additional steel reinforcement is required to connect wing walls and pilasters to a foundation wall. Both wing walls and pilasters are typically the same width as the foundation wall.

Regardless of the wall forming system, the procedure for construction of a cast-in-place concrete foundation wall is the same. Footing formwork is laid out and constructed, typically using 2 × 6s, 2 × 8s, or 2 × 10s, depending on the footing dimensions. Concrete is placed for the footings and is allowed to cure. When the concrete footing has attained the required strength to support the wall forms, the forms are set into place. Layout lines are snapped on the footing according to the dimensions specified on the foundation plan. Wood plates are nailed to the fresh concrete footing to hold the foundation wall forms in place. Wall ties are placed as the setting of the wall panels proceeds. Blockouts for basement doors and windows or beam blockouts are set in the forms at the proper locations as noted on the foundation plan. As with the footings, reinforcing steel is set in the wall to improve the tensile strength. Forms are plumbed, aligned, and braced. Marks or reference points are made inside the forms to mark the elevation for the top of the concrete.

Concrete is placed in the forms and consolidated to prevent air voids and segregation of the concrete mixture. When the concrete has obtained the proper height, anchor bolts are placed in the top of the concrete to secure the sill plate to the foundation. See Figure 7-6. A variety of bolt designs are available, with J-bolts being the most common design. A bent anchor bolt, such as a J-bolt, locks securely into the concrete wall due to its shape. The most common size anchor bolt used in residential construction is ½″ diameter. Per the *International Residential Code*, anchor bolts must extend a minimum of 7″ into the concrete and be placed a maximum of 6′ OC. At least two bolts must be installed per section of sill plate, with one bolt located not more than 12″ from each end of the plate. An architect typically specifies the bolt diameter, length, and on center spacing on the foundation plan.

Brick-veneer construction requires anchor bolts to be placed toward the inside face of the foundation wall. The sill plate and stud wall erected over the anchor bolts provide a backing for the brick-veneer facing. A brick ledge built into the edge of the foundation wall provides a space to place the brick flush with the foundation wall. The brick is anchored to the wood framing with metal ties. Exterior wall sections or details show where the sill plates are to be positioned on the foundation wall.

For brick-veneer walls, foundation walls must extend at least 4″ above finish grade.

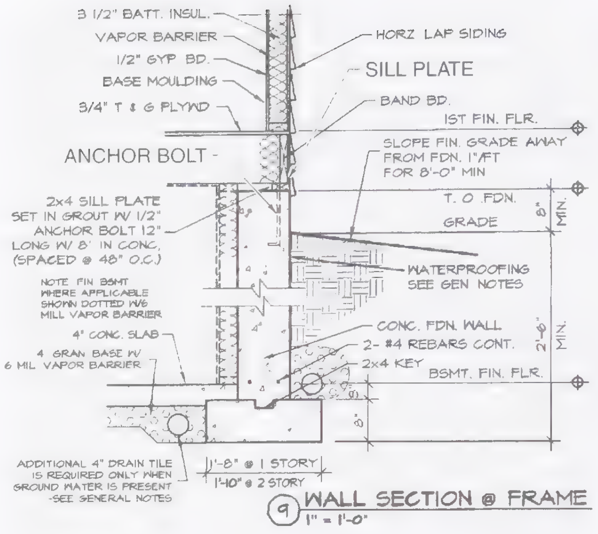


Figure 7-6. *Anchor bolts allow for attachment of wood framing members to the foundation wall. Anchor bolt position depends upon the type of construction.*

Insulating concrete forms (ICFs) are a specialized forming system consisting of a layer of concrete sandwiched between layers of insulating foam material. ICFs are manufactured with interlocking edges to fit together and create a form that retains the fresh concrete. ICF construction may also utilize adhesive to hold the forms together during concrete placement. See Figure 7-7. Plastic or steel form ties maintain the spacing and hold the ICFs in position during concrete placement. The ICFs remain in place in the finished structure, adding insulating properties to the foundation system.

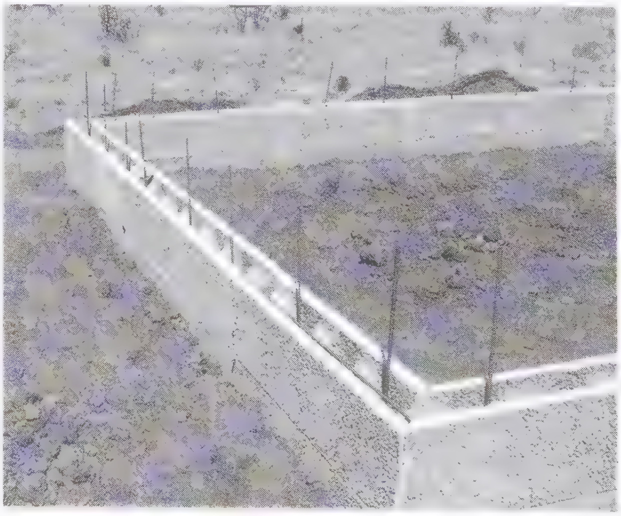


Figure 7-7. *Insulating concrete forms are lightweight foam sections that interlock to retain fresh concrete.*

Inverted-T Foundations

An inverted-T foundation system may be used when a basement is not specified. See Figure 7-8. An inverted-T foundation system is used for short foundation walls, such as for a crawl space. A building site with soil that has good load-bearing properties close to the earth's surface is well-suited for an inverted-T foundation system. Concrete for an inverted-T foundation may be placed monolithically (as one unit) for short foundation walls, eliminating the keyway between the foundation footing and wall. A keyway is avoided where possible since it acts as a source for moisture entering the crawl space.

Local building codes specify minimum vertical clearances between the bottom of the floor joist and the finish grade in the crawl space. An 18″ minimum vertical clearance is required in many parts of the United States.

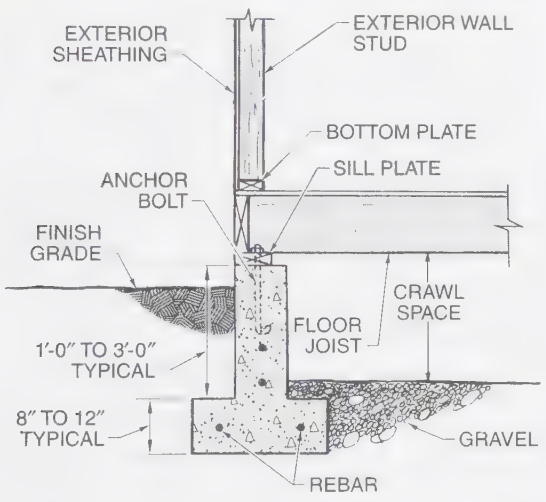


Figure 7-8. An inverted-T foundation has shallow footings and short walls. Inverted-T foundations are typically used with a crawl space.

Foundation Footing and Wall Forms. The profile of an inverted-T foundation is the same as a conventional foundation footing and wall except that the vertical portion of an inverted-T foundation is very short. The forming procedures for inverted-T foundation walls are similar to those used for conventional foundation walls. Prefabricated forms, ICFs, or job-built forms may be used as concrete forms. Footing forms and foundation wall forms are erected as one unit. A top is placed on the footing forms to prevent concrete from running out of the forms during placement. The concrete for footings and walls is placed in the forms at one time. Reinforcing steel and anchor bolts are placed in the concrete.

Foundation walls are subject to hydrostatic pressure from groundwater. Below-grade portions of foundation walls must be properly waterproofed.

Slab-on-Grade Foundations

A slab-on-grade foundation is used where a basement or crawl space is not included in the design. See Figure 7-9. Slabs-on-grade are also constructed for use under manufactured homes to provide a level surface and adequate anchoring. Excavation, mechanical, insulation, and reinforcement requirements must be considered when constructing slab-on-grade foundations.

Slab-on-grade foundations are not practical on steep lots. Slab-on-grade foundations are commonly used where a high water table exists. Stub-ins for plumbing and lateral electric service are made before concrete is placed for the slab.

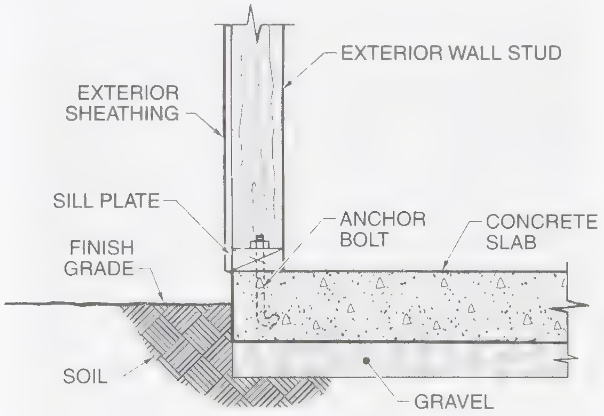


Figure 7-9. A slab-on-grade foundation system does not have a basement.

Excavation. Soil has a tendency to heave and shift as freezing and thawing occurs. Depth of frost penetration and frequency of the freeze-thaw cycle depend on the geographical region in which a house is being constructed. In warm climates, the freeze-thaw cycle is not a problem, making slab-on-grade foundations popular in these areas. In cold climates, excavation is required around the perimeter of a slab-on-grade foundation to prevent the condition caused by the freeze-thaw cycle from disturbing the structure. Local building codes require a certain depth of excavation, depending on the frost line (the depth to which the ground freezes). A frost wall may be required around the perimeter of

the slab. A frost wall blocks intrusion of ground frost and prevents the freeze-thaw cycle from damaging the foundation and the floor slab.

Heavy load conditions at certain points of the structure also require footings to be placed under sections of slab-on-grade foundations. Footings are required at exterior load-bearing walls and at various locations in the center area of the slab to support the loads of interior partitions and columns. See Figure 7-10.

After frost wall, footing, and electrical and mechanical excavation, the ground in the slab area is graded to the proper elevations as indicated on the foundation plan. Gravel or rock as specified on the prints is spread to an even thickness to provide a solid base for concrete and to alleviate water pressure differences that may occur under the slab.

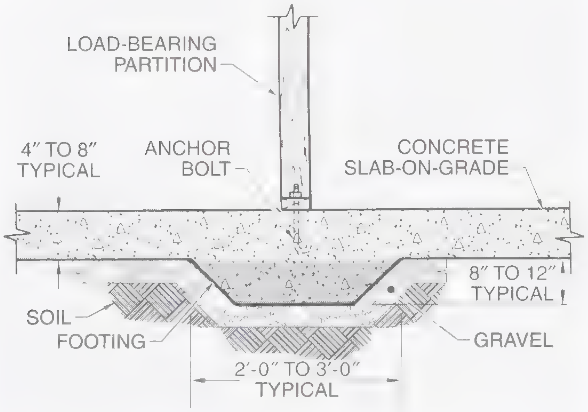
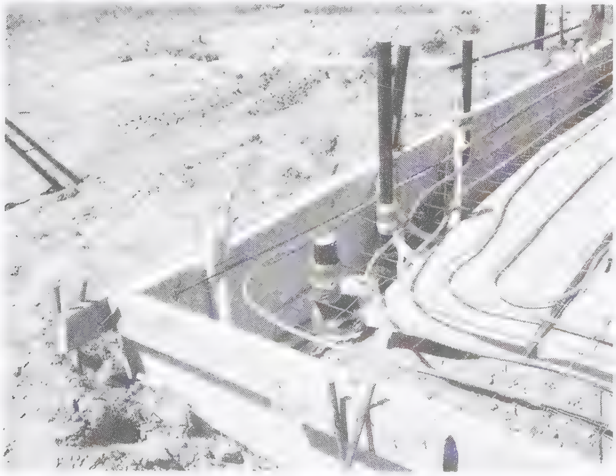


Figure 7-10. Thickened sections of slab-on-grade foundations form footings for greater load-bearing capacity.



Stub ins for plumbing and underground electrical service must be made before placing concrete for a slab-on-grade foundation.

Electrical and Mechanical. For slab-on-grade foundations, lateral plumbing pipes, electrical conduit, and heating and air conditioning ducts are placed in the proper position on the ground or in trenches before the concrete is placed. Trenches for pipes, conduit, and ducts are excavated as necessary to keep them below the slab. Pipe that projects up into the area above the slab are temporarily capped to prevent them from filling with concrete or other debris during concrete placement.

Vapor Barrier and Insulation. Concrete slabs placed directly on the ground will absorb moisture from the soil below, thus damaging finish flooring materials. In cold climates, the concrete also conducts cold from below the slab into the living space in the winter months. A vapor barrier is installed over the gravel base to prevent moisture from seeping up to the concrete slab. Thermal insulation is placed over the vapor barrier to keep the floor warmer. See Figure 7-11.

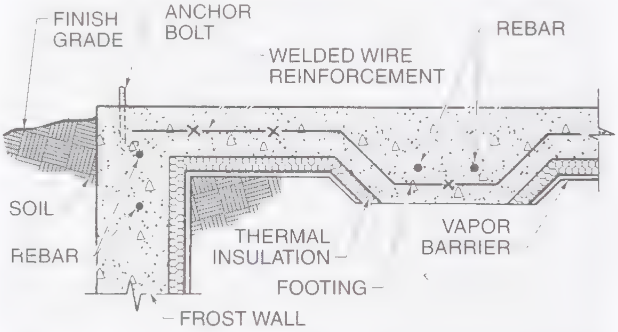


Figure 7-11. Insulation and vapor barriers placed between the concrete and the ground allow less thermal transmission from the ground to the floor slab.

Reinforcement and Anchoring. Depending on the load requirements, welded wire reinforcement, also known as welded wire fabric, is placed in the slab. The reinforcement increases the concrete slab strength in the same way that rebar increases strength in a conventional concrete foundation. In addition, the welded wire reinforcement prevents cracking and heaving of the slab. Rebar is commonly installed in footings of slab-on-grade foundations to strengthen the footings.

As the concrete is placed and begins to set, anchor bolts are placed in the concrete where exterior walls are to be fastened to the slab. Interior partitions are attached to the concrete slab with powder-actuated fasteners. Placement of anchor bolts for interior partitions creates difficulty in finishing the slab. For manufactured housing, anchors are incorporated into the slab to tie down the unit at the time of installation.

Piers and Grade Beam Foundations

Piers and grade beam foundations are used where poor soil conditions exist near the earth's surface. Piers are driven to below-grade bearing points where adequate structural support exists. Grade beams span the horizontal distance from pier to pier and act as foundation walls. See Figure 7-12.

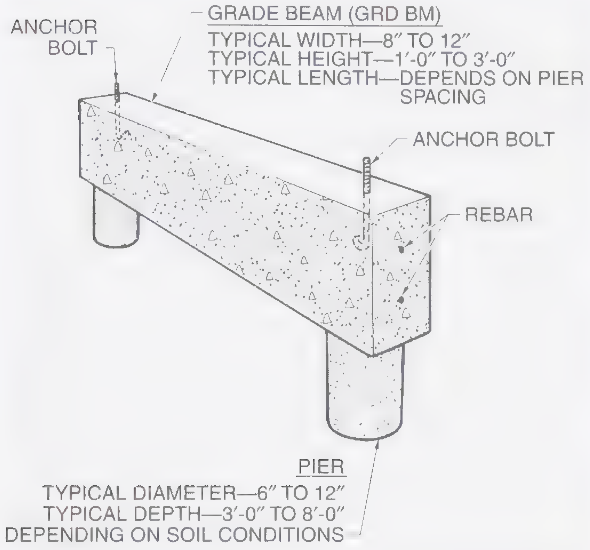


Figure 7-12. Piers support grade beams in a pier and grade beam foundation.

Grade beams should extend at least 8″ above the finish grade of the lot, and the bottoms must be below the frost line.

Piers. Pier holes are drilled into the ground to the depth required to reach solid load-bearing conditions and then filled with concrete. Pier holes are typically dug with a portable drilling rig or auger attachment on excavating equipment. Rebar is placed vertically in the pier holes as shown on the foundation plans and projects out of the top of the piers for securing to the grade beam.

Piers are not used exclusively with grade beams. Piers are also used in conjunction with other types of foundation systems, such as conventional foundation footings and inverted-T foundations, to provide added structural support where these foundation systems are installed over fill dirt or loose shifting soil.

A stepped foundation may be used on a steeply sloping building lot.

Shallow piers are commonly used to support porches, walks, and decks. Shallow piers are dug to a depth just below the frost line to prevent heaving due to freeze-thaw cycles. Piers can also project above finish grade to become a foundation for a manufactured, prefabricated, or conventionally framed house.

Grade Beams. A grade beam is a short concrete wall that spans and supports loads between piers. Below-grade grade beams are formed by excavating a trench to the depth and width shown on the foundation plan and filling it with concrete. When a grade beam is to project above-grade, conventional forming methods are used to construct the grade beam.

Concrete for grade beams is placed separately from the piers. Steel rebar is required in the grade beams and is positioned during or before concrete placement. Anchor bolts are installed in a grade beam in a manner similar to the conventional concrete foundation system.

Masonry

The most common material used in constructing masonry foundations is the concrete masonry unit (CMU). CMUs are available in many sizes and finishes. See Figure 7-13. New materials have been developed to improve masonry insulation properties.

Nominal Sizes of Concrete Masonry Units

Figure 7-13

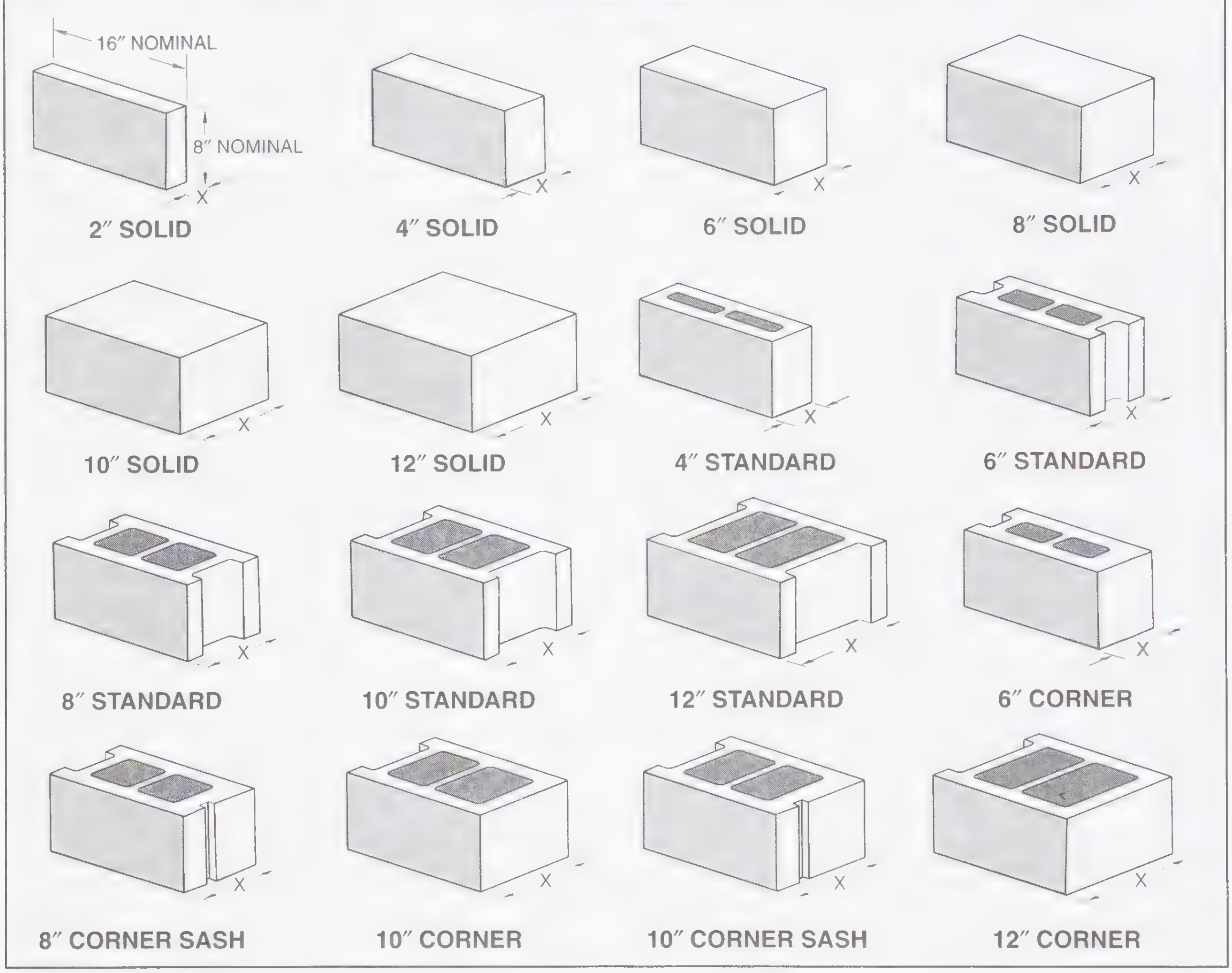


Figure 7-13. Concrete masonry units are available in a variety of sizes.

CMU Installation. The common method of installing a masonry foundation is to place the CMUs on a concrete footing similar to a footing used for a conventional concrete footing. No keyway is formed in the footing; the CMUs are laid on a smooth surface. Depending on the design requirements, vertical rebar may be installed in the footing and project up into the courses of CMUs.

CMUs are laid directly on the footing. CMUs for the corners are laid first, several courses high. Strings are stretched from corner to corner to maintain alignment and equal spacing for intermediate CMUs in the courses. Rebar, welded wire reinforcement, and insulation may be installed as each progressive course of CMUs is laid. See Figure 7-14.

Cores in the CMUs along the top courses are filled with mortar and anchor bolts set into the proper position. Anchor bolt spacing depends on the type of exterior walls or framing to be used and information included in the specifications.

Portions of below-grade masonry walls must be properly dampproofed from the top of the footing to the finish grade. Masonry walls must have at least ⅜″ of portland cement parging applied to the exterior face of the wall.

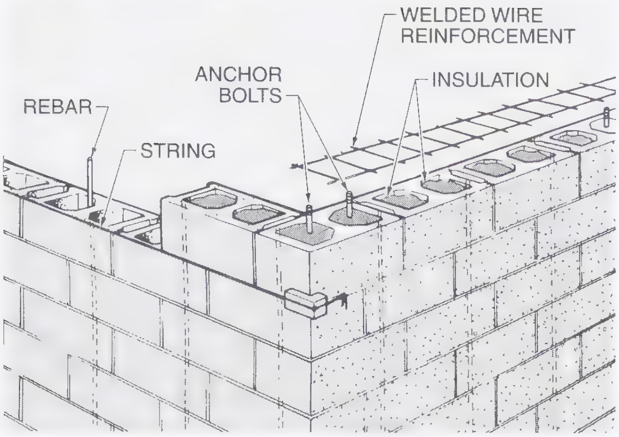


Figure 7-14. Concrete masonry units are laid from the corners first. Reinforcement, insulation, and anchor bolts are placed during construction.

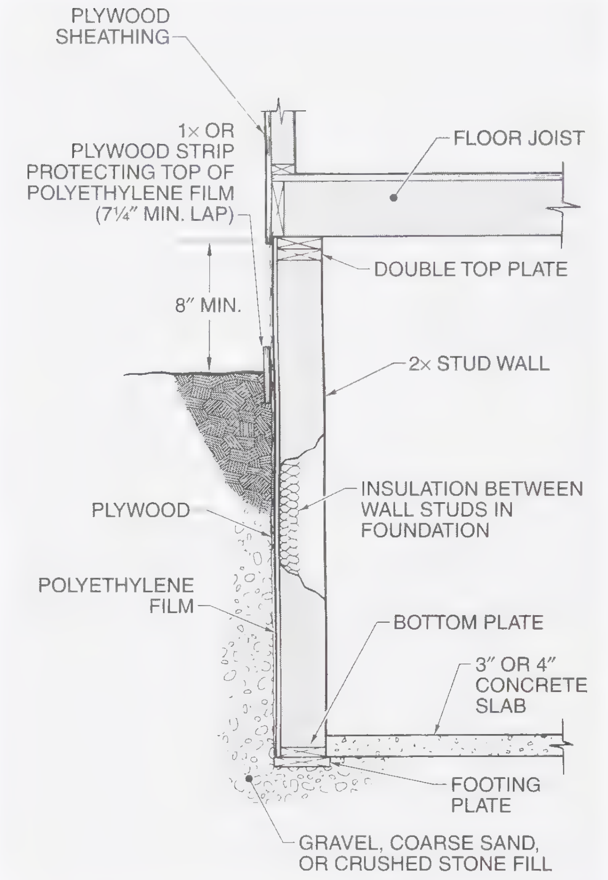


Figure 7-15. Wood foundations are constructed according to the manufacturer's detailed recommendations. Polyethylene film placed over the exterior face of the foundation wall and gravel provide adequate drainage.

Wood Foundations

Foundation materials must be decay- and insect-resistant. Developments in treatment processes have increased the use of wood as a foundation material. Various chemical treatments have been developed for plywood and framing lumber that make them usable for both above- and below-grade foundations.

Wood foundations can be installed in cold climates when freezing conditions prevent placement of concrete or masonry. With wood foundations, it is also easier to attach insulation and interior finish materials to the interior wood framing. Durability, cost, and installation time are comparable to the other residential foundation systems.

Footings. Two types of footings are used with wood foundations. One type of footing consists of several inches of compressed gravel spread below the footing. See Figure 7-15. Wide pieces of treated lumber (2 × 10s or 2 × 12s) are placed on the gravel end to end and nailed together. The other type of footing used for wood foundations is a conventional cast-in-place concrete footing. No keyway is formed in the footing.

Foundation Walls. Foundation walls are framed like conventional wood-framed walls using different construction materials. The walls are framed with pressure-treated lumber, and pressure-treated plywood panels are attached to the outside of the frame. The framing and plywood is sufficient in strength to resist the lateral soil pressure and support other loads imposed by the building. The framed panels are set in place and fastened together. All joints are caulked to prevent air and moisture penetration. Polyethylene sheets are draped over the outside of the foundation walls before backfilling to minimize soil contact with the plywood.

Piles

Piles are long support members driven or drilled deep into the ground. Wood is the most common material used for residential piles. Drilled-in-place piers are also a type of pile.

Piles are installed where adequate load-bearing soil is not reached until a greater depth is achieved. See Figure 7-16. Piles may also be installed for residential applications where houses are elevated above ground level, such as on houses constructed near flood plains or along tidal areas.

Layout stakes are placed to mark the exact locations where piles are to be driven. The pile is then lifted into place by a crane and set on end. A pile-driving hammer, mounted on the crane, is used to drive the pile into the ground. A minimal amount of excavation is required when driving piles.

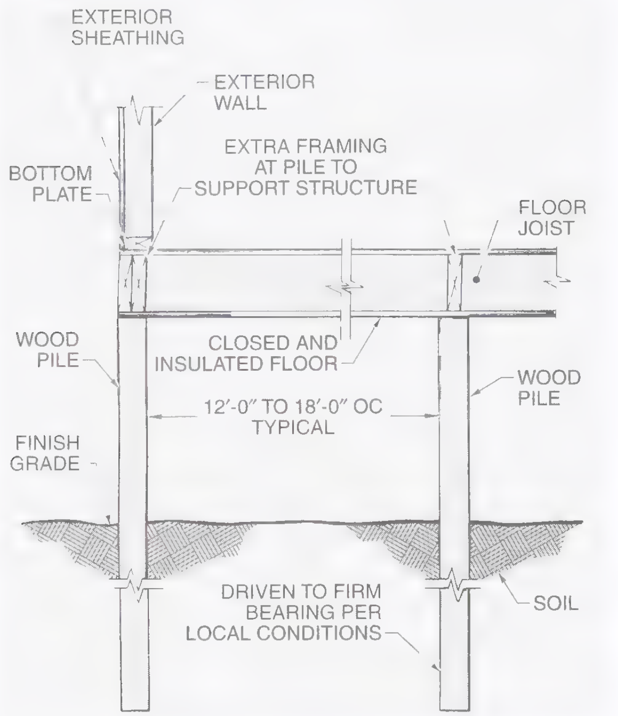


Figure 7-16. Houses constructed in low-lying areas may be supported with wood piles.

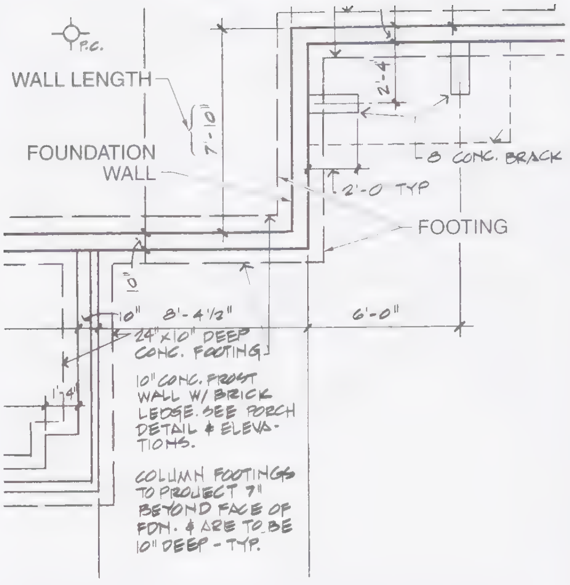


Figure 7-17. Foundation wall lengths are expressed in feet and inches.

FOUNDATION INFORMATION

An architect provides as much information as possible about foundation systems on the foundation plan. Each foundation type has its own particular components. Not all of the components for each type of foundation system may be shown on the foundation plan. The foundation plan includes horizontal dimensions, sizes of structural components, types of materials, window and door opening sizes and locations, utilities, floor finishes, framing, and information used for estimating foundation materials.

Horizontal Dimensions

Dimensions on a foundation plan provide information about location and length in a horizontal plane. The horizontal dimensions show wall length, footings, column and beam locations, and sizes and locations of foundation openings. See Figure 7-17.

Wall Lengths. The lengths of foundation walls are shown with extension and dimension lines. Length is expressed in feet, inches, and fractions of an inch. The dimensions shown on foundation plans indicate the actual wall length.

The foundation dimensions indicate the overall size of the house. The only additions to the overall house size are cantilevered areas shown on the floor plan.

Footing and Column Locations. Footings support the perimeter foundation walls and any columns or load-bearing walls in the interior of the structure. Locations for the footings are shown on the foundation plan.

Footings for exterior perimeter walls are indicated by hidden lines. Hidden lines are used because the footings are not visible on the imaginary slice taken for the foundation plan. The footings for interior columns and load-bearing walls are also shown with hidden lines.

Locations for piers and piles used for footings are shown on foundation plans with centerlines. Dimensions are indicated to the center of each pier or pile from two edges of the house.

Column locations are shown in the same manner as piers and piles using centerlines. An interior footing is required for support wherever a column is to be placed.

Beam Locations. Beam locations are shown even though they are above the cutting plane of the foundation plan. Showing beam locations is necessary so blockouts, used to form pockets that receive beams, can be provided in the foundation walls. See Figure 7-18. The blockouts are formed in the foundation walls as the forms are being constructed. A minimum bearing surface of 4″ and ½″ clearance on sides and ends of pockets is required. Information about beam locations is also used to order the proper length beams.

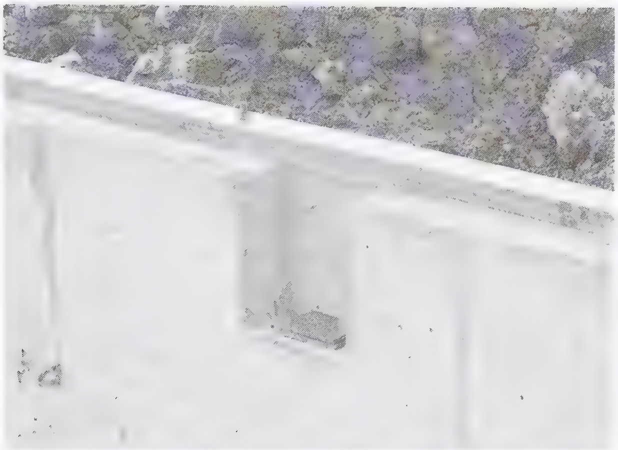


Figure 7-18. Beams are set into pockets in foundation walls.

Sizes of Structural Components

Structural support is the main function of the foundation. Support conditions and loads change from one part of the building to another. Footings, foundation walls, columns, and beams are constructed to the sizes specified on the foundation plan in order for them to provide the structural support for which they were designed and engineered. See Figure 7-19.

Footings. Perimeter wall footing sizes may not always be shown on a foundation plan. The sizes and depths of the footings are usually indicated on sections and details. Sizes for interior column footings and load-bearing partition footings are shown on the foundation plan using extension and dimension lines and notations.

Special notations regarding footing sizes, types, and elevations may be included on the foundation plan. Each footing is designed to support a specified load. During construction, tradesworkers must verify the size of each footing individually to ensure proper structural support is provided for the remainder of the building.

Drilled-in-place piers have sizes indicated with a notation identifying the diameter and depth of the drilled hole. The pier diameter is needed when calculating the volume of concrete required for the piers.

Pile sizes are indicated by a notation on the foundation plan. Wood piles are classified as A, B, or C piles, based on diameter and length.

Foundation Walls. Foundation wall thickness is important for providing proper structural support. Wall thickness and size may not be uniform throughout an entire house. Different soil types and load conditions require different wall thicknesses. Foundation wall thickness is indicated in the same manner as wall length, with extension and dimension lines. Dimensions are expressed in inches.

Foundation wall thickness affects the thickness of the jambs and blockouts that are to be formed in the wall, such as door and window jambs. The proper thickness jamb is ordered according to the wall thickness indicated on the foundation plan.

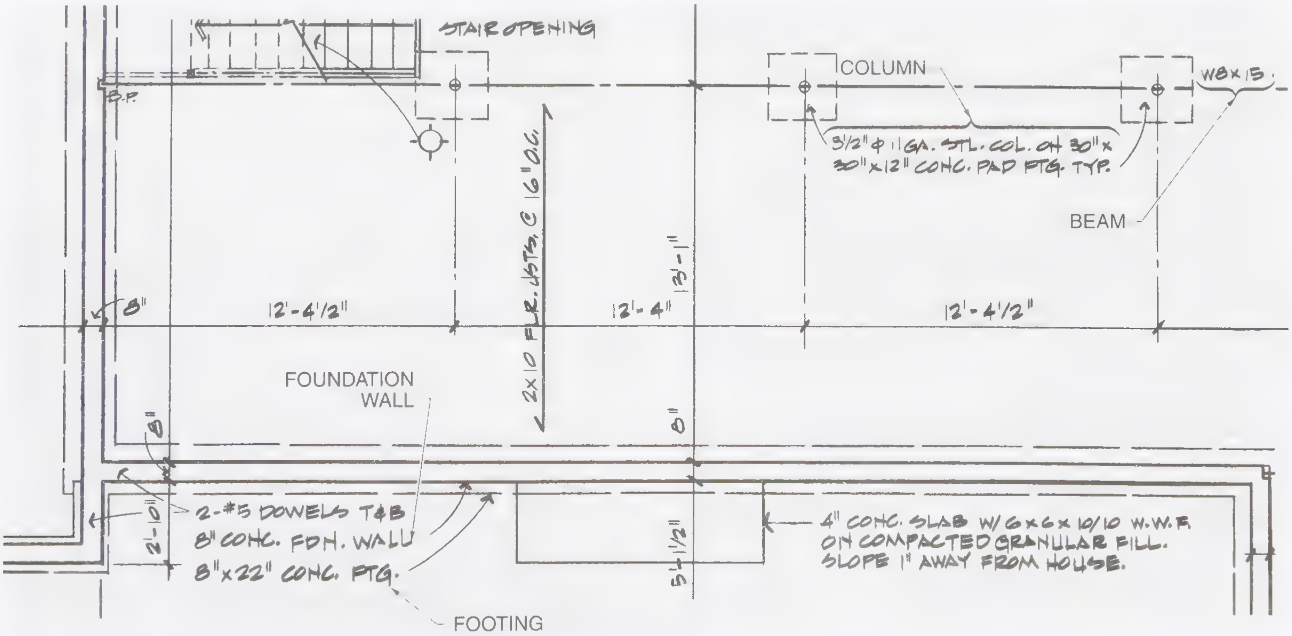


Figure 7-19. Sizes of footings, foundation walls, columns, and beams are shown on foundation plans.

Columns. Columns are encountered directly in the cutting plane for the foundation plan. Column sizes are indicated on a foundation plan by a notation. Column size depends on the type of material used for the column. For round columns, column size is expressed as the diameter (typically in inches). For square columns, column size is expressed as the outside dimensions of the column.

A typical notation for a column might read, "3½″ ø 11 GA STL COL ON 30″ × 30″ × 12″ CONC PAD FTG TYP." This notation indicates a 3½″ diameter 11 gauge steel column on a 30″ × 30″ × 12″ deep concrete pad footing, and is typical for all columns and pads shown (unless otherwise specified).

Beams. Beam sizes are indicated on a foundation plan even though beams are to be installed above the cutting plane. Beam sizes are based on the load to be supported and the type of material designated for the beams. Methods of expressing beam size vary according to the materials used. Steel beam sizes are designated using abbreviated descriptions that indicate the beam design, height, and weight per foot. For example, a W14 × 34 beam is a wide-flange beam that is 14″ high and weighs 34 lb per foot. Beam height and width dimensions are used to determine the size of the pockets in the foundation walls. The blockouts for the pockets are constructed slightly wider (½″ minimum on sides and end) than the beam to allow for easy insertion of the beam into the pocket.

Steel beams and columns are commonly used to support first-floor joists in residential construction.

Foundation Materials

A variety of decay- and insect-resistant materials are used in foundation construction and are shown on the foundation plan with various abbreviations and symbols. The structural qualities of each material are taken into account by the architect as the foundation is designed. The construction materials used in each foundation system have different installation and finish requirements.

Abbreviations and Symbols. Space limitations on the foundation plan prohibit spelling out each type of material. Therefore, abbreviations and symbols are used to describe foundation construction materials.

Multiple Materials. More than one type of material may be used in the construction of any foundation component. Materials are combined in a component to provide various support or appearance conditions required by the architect. The tradesworker interpreting the prints must be familiar with standard abbreviations and symbols to identify and recognize changes in material usage.

Decay and Insect Resistance. Materials used for foundation construction are in contact with soil and moisture. Materials specified on foundation plans are chosen because they are not susceptible to decay and insect destruction.

Metal termite shields may be required by local building codes. Termite shields are installed between the sill plate and top of the foundation wall.

Insulation. Proper thermal insulation is important in all parts of a house, including foundations. Many systems are used to increase the insulating capability of foundations. Insulating concrete form (ICF) materials integrate insulating properties of foam with the strength of cast-in-place concrete. Foam inserts or loose insulation is placed in CMU foundations to increase the insulating properties. Dense foam sheets are placed under concrete slabs-on-grade and on the interior of concrete and masonry walls. Wood foundations are insulated with fiberglass batts.

Windows, Doors, and Openings

Foundation openings are provided for a variety of applications, including ventilation, access, and placement of electrical, plumbing, or mechanical fixtures,

whether or not a house has a basement. In houses with a basement, windows and doors are included in the foundation design.

For concrete or masonry construction, finish metal window frames and door jambs are installed in the form walls and secured in place with temporary fasteners. Brackets attached to the outside of the frames and jambs extend into the concrete when it is placed. When window or door jambs are to be installed later, a framed buck (large blockout) is provided that is slightly larger than the window or door jamb to allow for later installation.

Placement. Foundation opening locations are indicated on a foundation plan with dimension and extension lines. Locations are indicated to the edge or center of each opening. Location dimensions are typically taken from the corner or edge of the building. Where openings are placed in the foundation walls, proper headers and reinforcement above and on the sides of the opening are required to ensure proper structural support. Placement of openings also has an effect on the interior and exterior finish if certain finishes are specified.

Where basement windows and openings are placed below the finish grade of the lot, areaways or window wells are provided. Prefabricated corrugated metal or plastic sections or short concrete walls are constructed on the outside of the opening to keep the area open. Areaways are most commonly installed or constructed after the foundation is completed but before finish grading of the lot occurs. See Figure 7-20.

Size. Opening size is indicated with extension and dimension lines along with the location. The architect may also include a notation describing the window or door type.

A framed buck is installed when window or door jambs are to be installed after the foundation walls are completed.

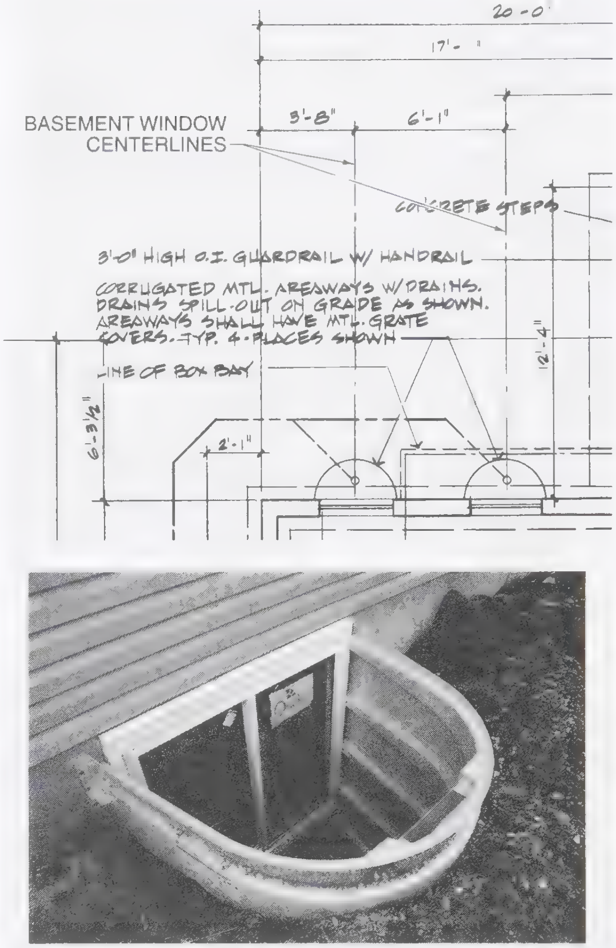


Figure 7-20. Window wells provide open areas outside of basement windows.

Utilities

An architect designs a house so utility services and fixtures are located away from the living area whenever possible for safety and aesthetic reasons. The main electrical service panelboard, plumbing connections, and mechanical equipment is located in the basement if possible. For a crawl space or slab-on-grade foundation, utility stub-ins are placed before the crawl space is covered or the concrete for the foundation slab is placed.

Electrical. Electrical features commonly indicated on a foundation plan include the basement ceiling luminaires (lighting fixtures), switches, washer and dryer outlets, main electrical service panelboard location, and various circuits that serve the electrical fixtures. See Figure 7-21. Electrical rough-in for the various

services is installed according to applicable sections of the National Electrical Code® as adopted by the permitting agency having jurisdiction in the area.

Plumbing. Features shown on the foundation plan pertaining to plumbing include fixtures such as water heaters and laundry connections. Bathroom facilities are indicated if a portion of the basement is to be finished. Floor drains and drain tile to be installed around the perimeter of the foundation footing for stormwater drainage are shown. The location of a sump well and pump, if required, are also shown on the foundation plan. Locations for water supply and natural gas pipes may also be indicated. Locations for future plumbing fixtures and equipment may be shown on a foundation plan, typically using hidden lines. See Figure 7-22.

Mechanical. Mechanical equipment, such as a furnace or air conditioning equipment, installed below or at grade may be shown on a foundation plan. For slab-on-grade foundations, ductwork sizes and locations may be shown on the foundation plan.

Figure 7-21. The main electrical service panelboard must be accessible to dwelling occupants.

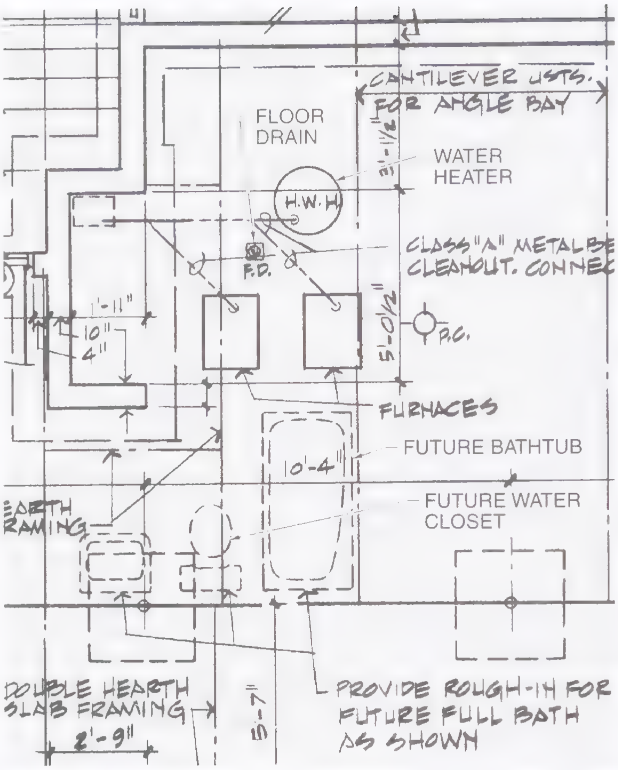


Figure 7-22. Floor drains, water heater connections, and basement bathroom information are shown on foundation plans.

Floor Finish

Basement floors may be finished, unfinished, or unexcavated. For a building with a basement, the foundation plan shows the finish of the basement floor. For a structure without a basement, other construction that is to be performed beneath floor level is described on the foundation plan.

In houses where the basement floor is finished, the most widely used material is concrete. The thickness of the concrete for the basement floor is indicated on the foundation plan. Basement concrete floor slabs are most commonly 4″ thick. During placement, the concrete floor is sloped down toward any floor drains placed in the basement. In areas of the basement that will be used for living areas, the floor remains mostly level and the finish flooring material, such as tile or carpeting, is indicated.

Some areas under a house may be designated to remain unfinished. These areas are entirely unexcavated or they are excavated to create a crawl space and covered with a porous material such as loose gravel. A plastic vapor barrier may be placed in these areas to prevent moisture from accumulating. Chemical treatment may be applied to the soil in these areas to provide termite protection.

Framing Information

Where the first floor of the structure is to be wood-framed, framing information is included on the foundation plan. Also, if any areas of the basement are to be finished, framing dimensions are shown.

Floor Joists. Floor joist sizes and spacing are indicated by a notation from the architect. See Figure 7-23. The direction in which the joists are to be placed is noted with an arrow parallel to the joists. Openings in the first floor, such as a stairway, may not be shown on the foundation plan. Stairway openings are shown on the floor plan. Part of the basement stairway may be indicated on the foundation plan.

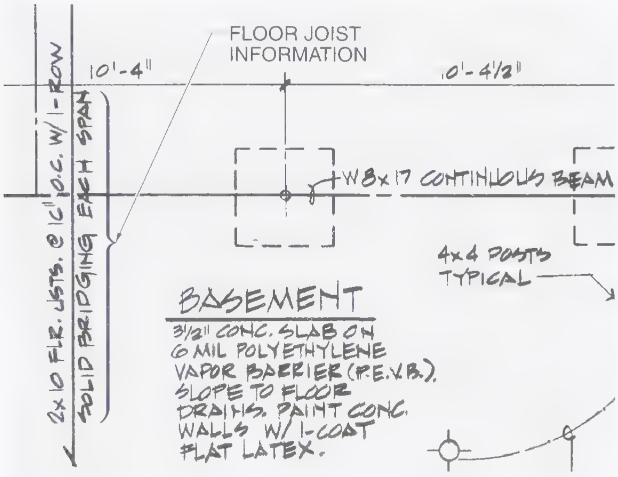


Figure 7-23. Floor joist information is provided on a foundation plan even though the joists are above the cutting plane.

Interior Partitions. Interior wall and partition locations and their dimensions are shown in a manner similar to the dimensioning used for exterior foundation walls. Dimensions may be shown to the face or center of the interior walls and partitions as indicated in a general notation on the prints. Information about wall finish materials is also included on the foundation plan.

Material Estimating

Information about foundation size and materials shown on a foundation plan is used to determine the required amounts of labor and materials needed to construct the foundation. See Figure 7-24. In addition, a contractor calculates the amount of forming materials required if a cast-in-place concrete foundation is to be used. Additional material amounts are added later to all the totals to allow for a certain small percentage of waste in construction materials.

Concrete. The volume of concrete required for a foundation can be determined from the length, width, and height of the footings and walls. The volume of concrete is calculated by multiplying footing and wall length by width by height and then dividing by 27 to determine cubic yards (27 cu ft = 1 cu yd). All dimensions must be expressed in feet. For example, the volume of concrete required for a foundation wall measuring 32′-0″ long by 8″ wide by 7′-6″ high is determined by multiplying 32′ by .67′ by 7.5′ (32′ × .67′ × 7.5′ = 160.8 cu ft). The total number of cubic feet is divided by 27 to calculate the volume in cubic yards (160.8 cu ft ÷ 27 = 5.95 cu yd). The 5.95 cu yd is rounded off to 6 cu yd.

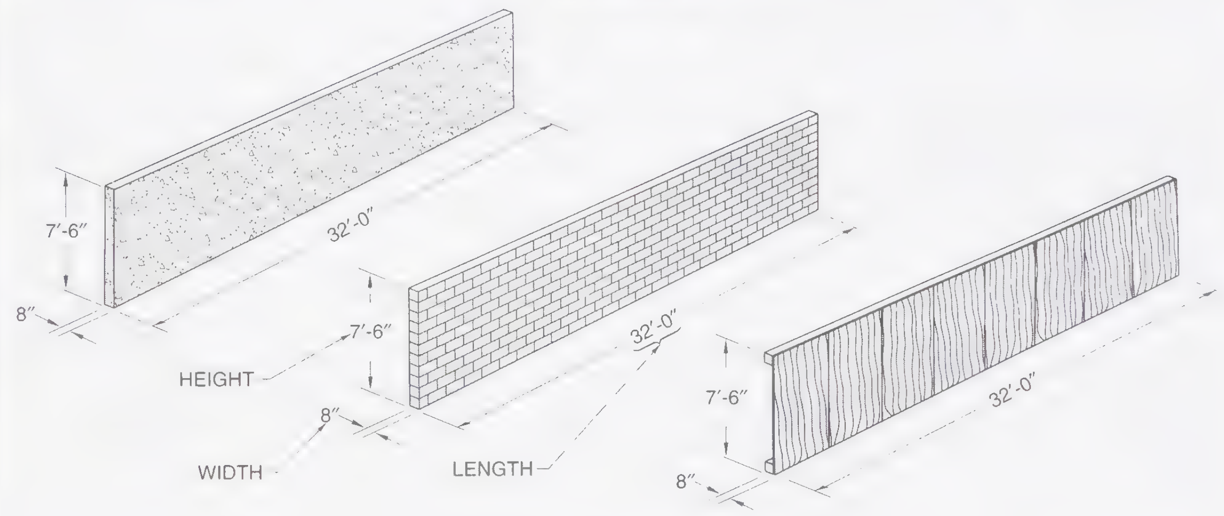
The amount of forming material needed for a cast-in-place concrete foundation wall is calculated by first multiplying wall length by wall height. This result is then multiplied by 2 to determine the area (in square feet) of forming material needed for both sides of the wall. The area is then divided by the area of the form panels that will be used to form the walls. Dimensions must be expressed in feet. For the wall used in the previous example, the wall length is multiplied by the wall height (32′ × 7.5′ = 240 sq ft). The result is then multiplied by 2 (240 sq ft × 2 = 480 sq ft). If 4′ × 8′ plywood panels are used to form the wall, the total area is divided by 32 sq ft (480 ÷ 32 = 15 panels). A total of 15 plywood panels will be needed to form the foundation wall.

Masonry. The number of concrete masonry units required to construct a foundation wall is determined by dividing the wall length by the length of one concrete masonry unit and multiplying this number by the required number of courses. Amounts of corner CMUs and other special CMU shapes are determined separately. To calculate the number of CMUs needed to construct the example wall with 16″ long by 8″ high CMUs, 32′ is divided by 1.33′ (32′ ÷ 1.33′ = 24 CMUs/course). To determine the number of courses, 7.5′ is divided by .67′ (7.5′ ÷ .67′ = 11 courses). The number of CMUs per course is multiplied by the number of courses to determine the total number of CMUs needed for the foundation wall (24 × 11 = 264 CMUs).

When estimating masonry foundation walls, additional materials such as mortar and joint reinforcement must be included in the estimate. Mortar quantity is determined using standard mortar quantity tables. The linear feet of required joint reinforcement is based on course spacing and length of walls.

Estimating Foundation Wall Materials

Figure 7-24



CONCRETE	MASONRY	PLYWOOD
$\frac{\text{length} \times \text{width} \times \text{height}}{27}$ = cubic yards	$\frac{\text{wall length}}{\text{CMU length}}$ × courses = CMUs	$\frac{\text{length} \times \text{height}}{32}$ = panels
$\frac{32 \times .67 \times 7.5}{27}$ = 5.95 cubic yards	$\frac{32}{1.33}$ × 11 = 264 CMUs	$\frac{32 \times 7.5}{32}$ = 7.5 panels
6 cu yd	**264 CMUs**	**8 panels**

Figure 7-24. Materials needed to construct foundation walls are estimated using the foundation plan, elevations, details, and other drawings.

Plywood. The number of plywood panels required for a wood foundation wall is calculated in the same manner as when calculating form wall material for concrete foundation walls. First, the area of the wall is calculated by multiplying the wall length by the wall height. The area is divided by the panel area to determine the number of panels required. All dimensions must be expressed in feet. For the example foundation covered with 4′ × 8′ panels, the wall length is multiplied by wall height (32′ × 7.5′ = 240 sq ft). The area is divided by 32 sq ft, which is the area of a 4′ × 8′ panel (240 ÷ 32 = 7.5 panels). When rounded up, 8 full plywood panels are required. Framing lumber is calculated separately, depending on the spacing of the studs.

Pressure-treated lumber and plywood panels are used to construct wood foundation walls.

ABBREVIATIONS AND SYMBOLS

Standard abbreviations indicate the components and materials used in foundation construction. Abbreviations require less space on the prints than fully written descriptions and reduce clutter on the drawings. Symbols are also standardized and show these components and materials in a graphic form.

Abbreviations

Architects use a standard set of abbreviations. See Figure 7-25. Most of the abbreviations can be determined relatively easily by a tradesworker who has a working knowledge of building components and materials. Some memorization of these abbreviations is required for a tradesworker to be completely confident and competent in interpreting prints.

FOUNDATION PLAN ABBREVIATIONS

COMPONENTS

Abbreviation	Term
BM	Beam
BSMT	Basement
CEL	Cellar
FLR or FL	Floor
FND	Foundation
FTG	Footing

MATERIALS

Abbreviation	Term
AB	Anchor bolt
AGG	Aggregate
CEM	Cement
CEM MORT	Cement mortar
CHAN	Channel
CIN BL	Cinder block
CONC	Concrete
CMU	Concrete masonry unit
EXP JT	Expansion joint
INS	Insulation
MOR	Mortar
OJ	Open web steel joist
REBAR	Reinforcing steel bar
ST or STL	Steel
WD	Wood
WWR	Welded wire reinforcement

PLUMBING

Abbreviation	Term
AD	Area drain
BLR	Boiler
CO	Cleanout
D or DR	Drain
FD	Floor drain
G	Gas
PLBG	Plumbing
SP	Soil pipe
WH	Water heater
WM	Washing machine

ELECTRICAL

Abbreviation	Term
EP	Electric panelboard
OUT.	Outlet
PS	Pull switch

OTHER ABBREVIATIONS

Abbreviation	Term
EXCA or EXC	Excavated
UNEXC	Unexcavated
UNF	Unfinished
WP	Weatherproof
WR	Water-resistant

Figure 7-25. Abbreviations conserve space on foundation plans.

Symbols

Standardized symbols pictorially represent an item or material. See Figure 7-26. On some sets of prints, an architect may include a table of symbols used on the drawings and their meanings.

OTHER FOUNDATION REFERENCES

More information about the foundation construction is required than can be contained on one section or sheet of the prints. The various drawings included in a set of prints work together to provide the comprehensive information needed to construct the house. Information is included on a variety of drawings throughout a set of prints that is related to foundation types, sizes, and materials.

Concrete is the most common material used for foundation walls because it is less susceptible to seepage than other materials.

Elevations

An elevation shows the foundation from a vertical plane. Exterior elevations show the foundation elevations, opening locations and sizes, and exterior foundation finish.

Elevations. Elevation dimensions at the top of the foundation wall or the top of the footing are indicated on elevations. See Figure 7-27. The elevation dimensions provide information used to determine the overall foundation wall height and depth of excavation required for the footings.

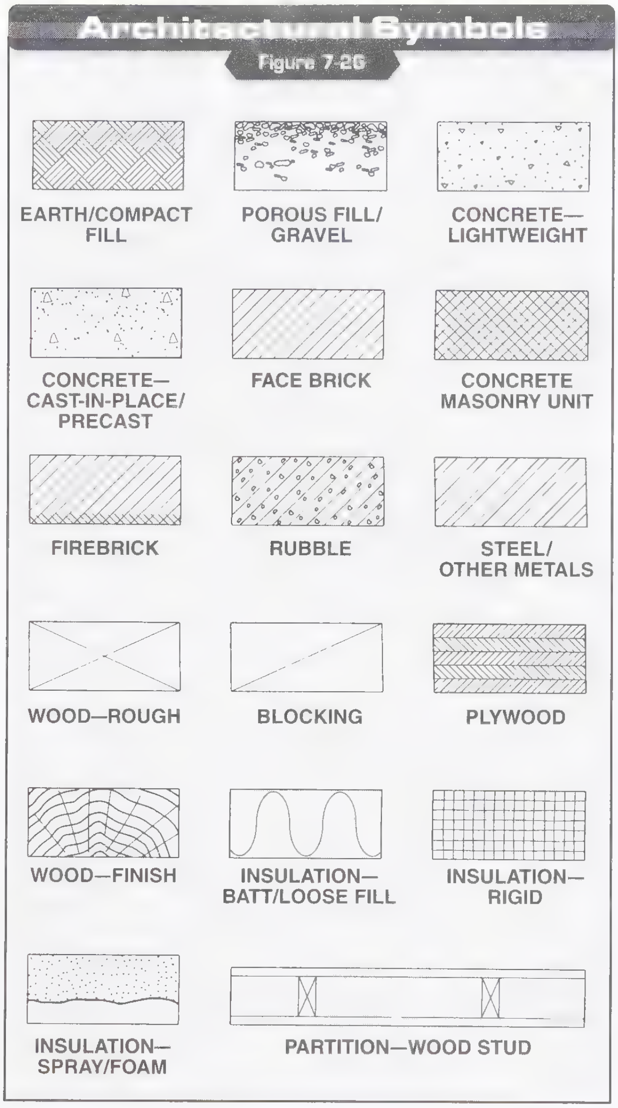


Figure 7-26. Architectural symbols are standard representations of common materials.

Openings. Elevations provide additional information about windows, doors, and openings that are in the foundation walls, including size, type, and location.

Exterior Finish. The architect may specify a particular finish for the exterior face of an exposed foundation wall. Some local building codes require that exterior foundation finishes be provided where certain conditions exist. The finishes are indicated on the elevations.

Specifications

The specifications list the types and grades of materials to be used in the foundation. In addition, proper practices to be followed during construction are specified. See Figure 7-28.

Concrete masonry units (CMUs) must be laid level and plumb to ensure a stable foundation wall.

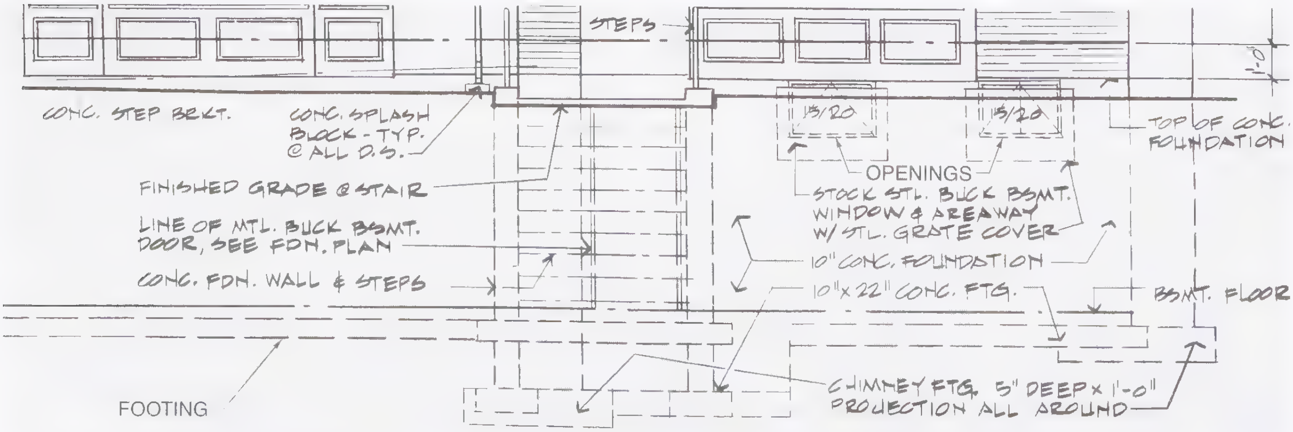


Figure 7-27. Foundation footings, foundation walls, and wall openings are shown with hidden lines on elevations.

FOOTINGS

1. Without soil test or engineer's seal and calculations the following minimum sizes are required:
   6″ × 12″ for garage walls supporting roof only
   6″ × 16″ for one story home without basement
   8″ × 20″ for one story frame home with basement
   8″ × 22″ for two story frame home with or without basement

Note: Frame home indicates frame with brick veneer.

2. The bottom of all footings to be a minimum of 2′-6′ below finish grade. Show stepped footings where required by adjacent grades and detail footing/foundation construction at excavation overdig areas.
3. Interior footings integral with concrete slab shall be a minimum 16″ wide × 12″ deep unless verified by calculations for smaller size.
4. Piers to extend a minimum of 2′-0′ into undisturbed soil and at least 30″ below finish grade.

CONCRETE

1. Minimum thickness of concrete floor slabs supported directly on the ground is 3½″. The slab shall be placed over a minimum of 4″ base coarse gravel or crushed stone. Slab must be dampproofed or waterproofed depending on presence or absence of ground water.
2. Minimum compressive strength of concrete slab shall be:
   2500 psi @ basement slabs.
   3000 psi @ basement walls, foundation walls, and footings.
   3500 psi @ porches, walks, patios, steps, garage and carport floor slabs and driveways
3. Concrete for all basement walls, foundation walls, porches, walks, patios, steps, garage and carport floor slabs and driveways shall be air-entrained.

Figure 7-28. *Foundation specifications provide information about material type and installation.*

Materials used in foundation construction must meet requirements for strength, stability, and insect and decay resistance. Materials that meet these criteria are listed in written form in the specifications. Concrete, masonry, ICFs, and plywood perform well as foundation materials when proper installation procedures are followed.

Details

Details provide an enlarged view of the footing and foundation wall specified by the architect. A vertical slice is taken through a foundation and is increased to a larger scale to show specific items. See Figure 7-29.

Footings. Information about footing width and depth dimensions is shown on details. Details are also the primary source of information about the type and placement of reinforcing steel in the footing.

Foundation Walls. Foundation wall thicknesses and materials are shown on details. Anchor bolt locations and reinforcing steel sizes, types, and placement may be indicated. Information regarding the types and placement of insulation or specialty materials to be installed in the foundation wall or under the foundation or basement floor is also shown on the details.

ECO-Block, LLC

The use of insulating concrete forms (ICFs) in residential construction is on the increase in many parts of the United States.

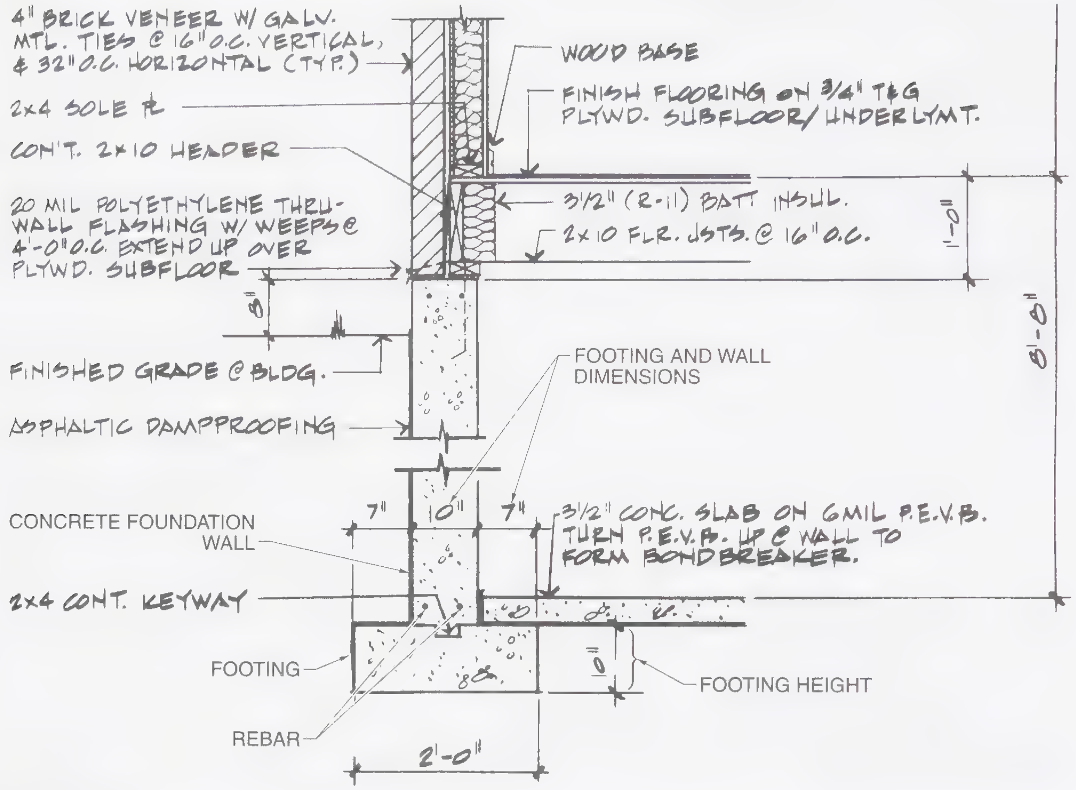


Figure 7-29. Footing and foundation wall sizes and materials are indicated on details.

REVIEW QUESTIONS

Foundation Plans

Name ______________________________ Date ______________

True-False

T F **1.** A cutting plane for a foundation plan extends in a horizontal direction.

T F **2.** Exact anchor bolt locations are specified on a foundation plan.

T F **3.** Two methods for squaring a corner are the 3-4-5 method and the diagonal measurement method.

T F **4.** Adding water to a fresh concrete mixture produces a stronger concrete.

T F **5.** Form ties are positioned between wall forms before concrete is placed in the forms.

T F **6.** Interior non-load-bearing partitions installed on a slab-on-grade are commonly fastened to the concrete with anchor bolts.

T F **7.** Pilasters extend the full height of a foundation wall.

T F **8.** Since beams supporting first floor joists are above the cutting plane, they are not shown on the foundation plan.

Multiple Choice

______________ **1.** A keyway ___.

A. improves the joint between the footing and foundation wall
B. prevents leaks in foundation walls
C. allows for the placement of basement windows
D. holds the floor joists to the top of the wall

______________ **2.** Anchor bolts in residential construction are typically ___″ diameter.

A. $\frac{1}{8}$
B. $\frac{1}{4}$
C. $\frac{1}{2}$
D. $\frac{3}{4}$

______________ **3.** Rebar used for residential foundations is typically ___″ diameter.

A. $\frac{1}{8}$
B. $\frac{1}{4}$
C. $\frac{1}{2}$
D. $\frac{3}{4}$

_______________ 4. The proper location for a grade beam is ___.
   - A. on the interior foundation columns
   - B. in and above the ground, spanning between piers
   - C. directly above a basement window
   - D. at the double top plate in a wood foundation

_______________ 5. Foundation plans show ___.
   - A. interior columns
   - B. elevations
   - C. property lines
   - D. overdig

_______________ 6. The footing on a foundation plan is indicated with ___ lines.
   - A. solid
   - B. leader
   - C. hidden
   - D. object

_______________ 7. Window locations are indicated on foundation plans with ___.
   - A. extension lines
   - B. architectural notations
   - C. centerlines
   - D. hidden lines

_______________ 8. Information regarding reinforcing steel used in residential foundations is included on ___.
   - A. elevations
   - B. plot plans
   - C. foundation plans
   - D. details

_______________ 9. The recommended type of footing for wood foundations is ___.
   - A. gravel
   - B. cast-in-place concrete
   - C. concrete masonry units
   - D. piers

Completion

_______________ 1. The cutting plane for a foundation plan view is taken at approximately ___ above the basement floor.

_______________ 2. The most common material for residential foundations is ___.

_______________ 3. Per the *International Residential Code*, the maximum spacing of anchor bolts is ___′ OC.

_______________ 4. A(n) ___ blocks intrusion of ground frost and prevents the freeze-thaw cycle from damaging a slab-on-grade foundation.

_______________ 5. When constructing a CMU foundation wall, the ___ are laid first.

_______________ 6. The abbreviation "STL COL" indicates ___.

____________ 7. Locations for piers are shown on foundation plans with ___.

____________ 8. The typical thickness of a concrete basement floor is ___″.

____________ 9. ___ project from concrete foundation walls to support porches or slabs.

Matching

____________ 1. Conventional concrete foundation footings and walls

____________ 2. Inverted-T foundation

____________ 3. Slab-on-grade foundation

____________ 4. Pier and grade beam foundation

____________ 5. Piles

____________ 6. Masonry foundation

____________ 7. Wood foundation

A. corners laid first

B. footings have keyway

C. used for deep bearing

D. no basement/crawl space

E. used at high water table

F. covered with polyethylene on exterior face

G. concrete for footing and foundation wall placed monolithically

[illegible]

Refer to the foundation plan on page 137 for questions 1 through 11.

T F **1.** Three columns are shown on the plan.

T F **2.** Floor joists are spaced 24″ OC.

________ **3.** The steel columns are ___″ diameter.

________ **4.** The length of foundation wall "A" is ___.

________ **5.** The length of foundation wall "B" is ___.

________ **6.** The center beam is (in feet and inches) ___ from the exterior face of the front wall.

________ **7.** The thickness of foundation wall "A" is ___″.

8. For A through K, write the meaning of the abbreviations and symbols shown on the foundation plan.

________ A.

________ B.

________ C.

________ D.

________ E.

________ F.

________ G.

________ H.

________ I.

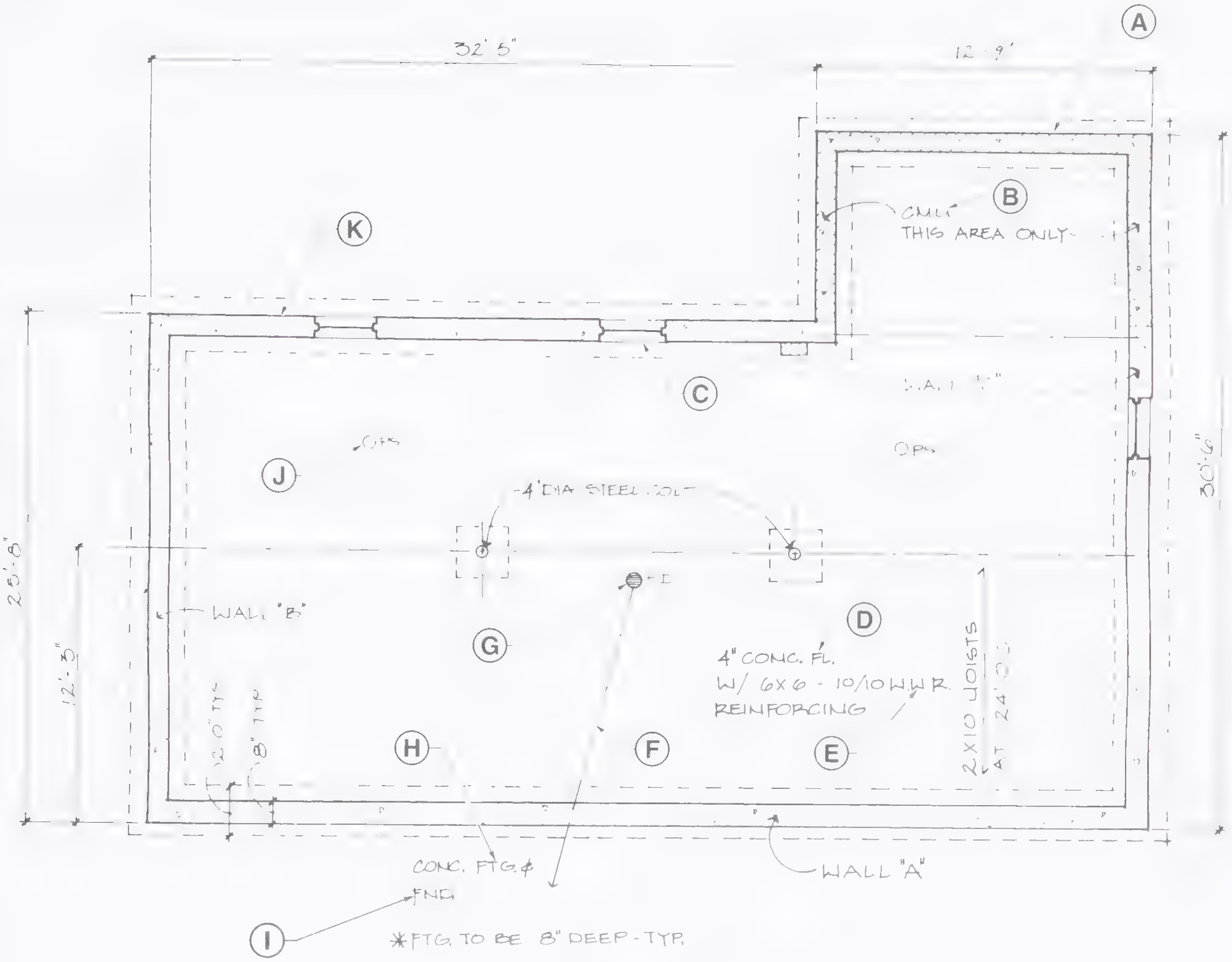
________ J.

________ K.

________ **9.** How many windows are to be installed along foundation wall "C"?

________ **10.** The concrete for the basement floor is ___″ thick.

________ **11.** How many cubic yards of concrete are required for the footing (excluding the column footings) for this plan?



Identification

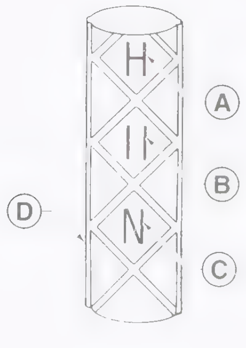
Identify the parts of a rebar.

____________ **1.** Bar size

____________ **2.** Producing mill

____________ **3.** Type of steel

____________ **4.** Main rib



Identify the foundation types.

________________ **5.** Slab-on-grade

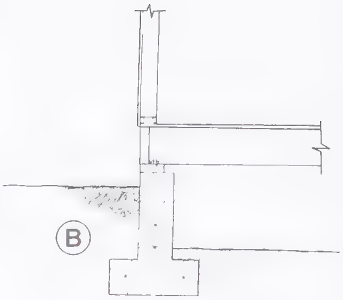
________________ **6.** Inverted-T

________________ **7.** Pier and grade beam

________________ **8.** Wood

________________ **9.** Piles

(A)



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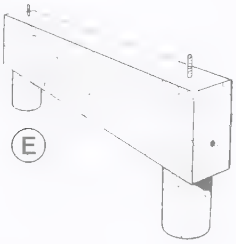

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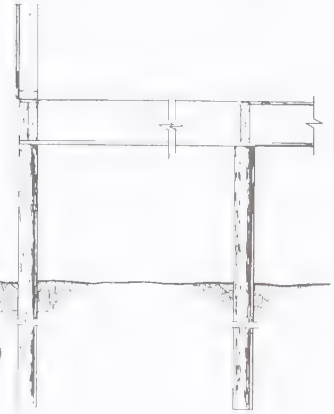
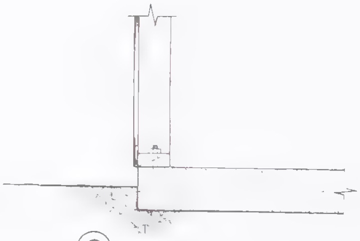


(D)



(C)

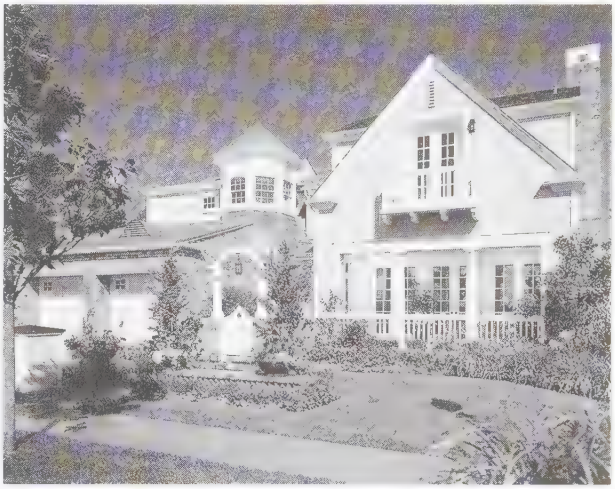
Chapter 8

Elevations

Exterior finish materials protect the structural members of a house from damaging effects of the weather and also provide an attractive appearance. Information about construction materials applied to exterior surfaces is included on exterior elevations. Doors, windows, and vent openings in exterior walls are also shown on exterior elevations. The roof type and roof coverings are also indicated.

Each exterior elevation shows one side of a house as it appears from an external, ground level view. Elevations are orthographic projections of the views. No compensation is made for distance, viewing angle, or perspective. Elevations are commonly labeled north, south, east, and west, or front, back, right side, and left side, according to the side of the house projected in the drawing.

Interior elevations provide information about finish materials to be applied to interior walls and locations of plumbing and electrical fixtures not shown in other views. Interior elevations are orthographic projections of interior walls.



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Various exterior finish materials, such as masonry and fiber-cement siding, can be combined to provide a pleasing appearance.

EXTERIOR FINISH COMPONENTS

The walls, roof, and all exposed areas of a house must be covered with weather-resistant materials to prevent air and water infiltration. See Figure 8-1. Overhanging areas, such as where an upper floor projects (cantilevers) above a lower floor or where the roof projects beyond the exterior walls, must also be properly finished.

Exterior Wallcoverings

Siding, plaster, exterior insulation and finish systems, and masonry materials can be used to cover the exterior walls of a house. Trim members are installed to secure the exterior finish materials in position, cover the joints between finish materials, and finish edges and corners. Joints at intersections and around doors and windows are sealed with flashing and caulking.

To minimize repetition and clutter on a set of prints, an architect often will only show the wallcovering on several small segments of the wall. Architectural notations and dimensions are included as needed in the open areas.

Cornices

A cornice is the area of a roof that projects past the exterior wall to form an overhang. Cornice trim consists of the fascia, soffit trim, frieze board, and other components.

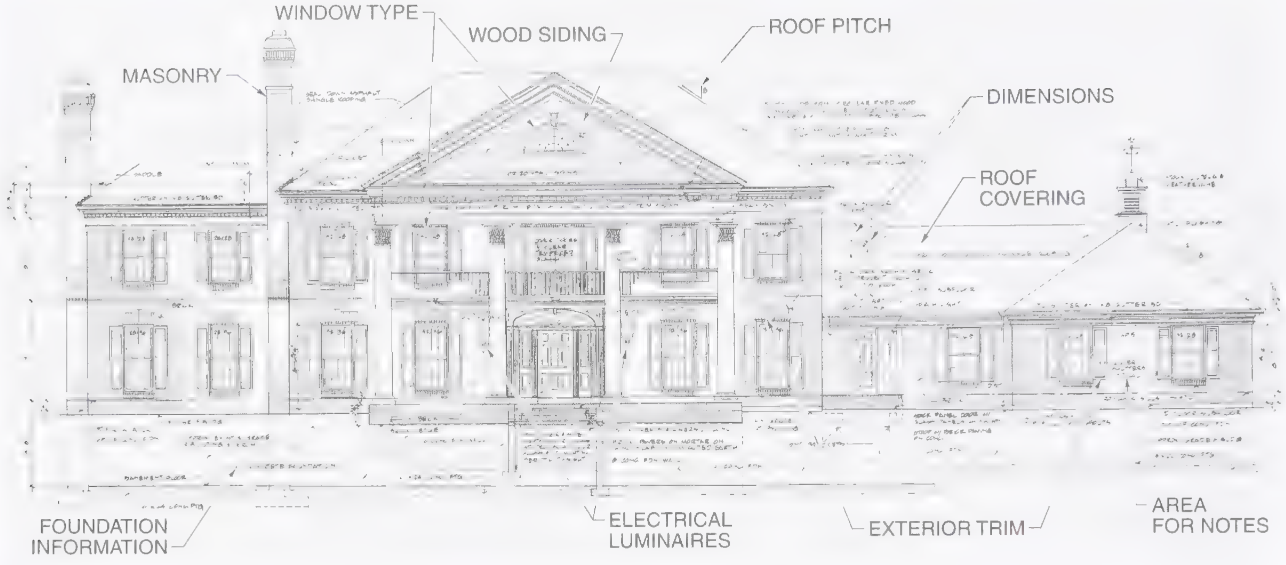

Figure 8-1. Weather-protective and ornamental items on the exterior of a house are shown on exterior elevations. Open areas on the elevations provide room for notations.

The underside of the overhang at the roofline is the soffit. Two types of soffit are open and closed. See Figure 8-2. An open soffit is closed at the wall line with bird blocks, which are constructed from 2× lumber cut to fit between the rafters. Bird blocks are the same height as the rafter material and are fastened in place to close the open area between the top plate and the underside of the roof sheathing. Holes may be drilled in bird blocks and covered with window screen mesh to provide additional attic ventilation.

A closed soffit is framed to support exterior trim members. Closed soffits are more common than open soffits due to their finished appearance. A closed soffit is constructed with finish materials installed directly onto the bottom of the overhanging portion of the rafters or to horizontal blocking and framing.

EXTERIOR FINISH MATERIALS

Exterior finish materials applied properly to the outside of exterior walls prevent air and water infiltration while providing the desired appearance. Various exterior finish materials can be combined on the exterior walls to create the desired effect. Exterior finish materials include siding made of wood, fiber cement, metal, and vinyl and other polymers; masonry and plaster; and exterior insulation and finish systems (EIFS). The abilities of these materials to withstand the effects of weather and provide adequate insulation vary.

Exterior wall sheathing is typically applied over the wall studs. A weather barrier is applied over the sheathing prior to application of exterior finish materials to provide additional wind and thermal protection for the house.

Wood Siding

Wood siding is a common type of exterior finish material. Types of wood siding include long, narrow pieces of tempered hardboard or lumber, large hardboard or plywood panels, and shingles and shakes. Wood trim members are used to cover siding joints. Different types of wood and wood-processing methods provide varying degrees of weather resistance. Most wood siding requires painting or staining to achieve long-lasting weather resistance.

An exterior building envelope consists of the exterior finish materials and weather barrier. The exterior finish materials are the first line of protection against air and water infiltration. The second line of protection is the weather barrier, which includes housewrap or building paper. Housewrap is a translucent spun-plastic sheet material that is tightly wrapped around a building. Asphalt-saturated felt and building paper are traditional weather barriers.

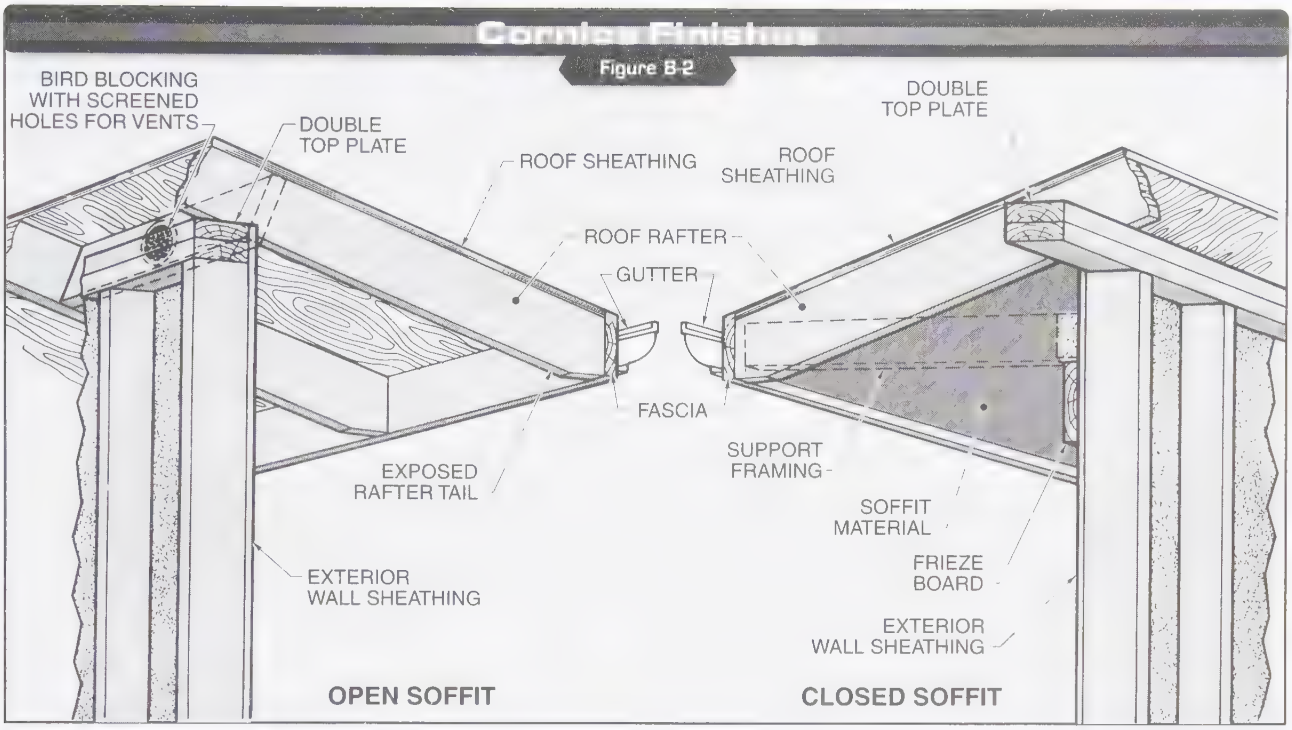

Figure 8-2. The area that projects past the exterior walls and roof is the cornice. Soffits on the underside of the cornice may be open or closed.

Lap Siding. Hardboard lap siding is ½″ thick, 4″ to 12″ wide, and 16′ long. See Figure 8-3. Hardboard lap siding is available with smooth or textured finishes. Wood flakes are glued and pressed together under intense heat and pressure to create tempered hardboard siding. An outer covering is applied to the siding for weather protection. Hardboard lap siding does not readily warp or twist. Solid lumber is also used for lap siding.

Beveled lap, shiplap, and clapboard siding are types of lap siding. Beveled lap siding is tapered in thickness from approximately ¾″ at the bottom to ⅛″ at the top and is available in 8″ to 12″ widths. Shiplap siding is designed to allow for the overlapping of pieces without increasing the thickness of the wallcovering. Clapboard siding is made of ¼″ thick square-edged boards and available in 4″ to 12″ widths and 8′ to 14′ lengths in 2′ increments.

Red cedar and redwood are two types of lumber commonly used for solid wood siding. Red cedar and redwood are applied as exterior siding because they are highly resistant to weather damage and decay.

Lap siding is applied horizontally to exterior walls starting at the bottom and working towards the top. Galvanized nails or staples are used to fasten the siding to the walls. Each successively higher siding course overlaps the lower course by approximately 1″. The amount of siding not covered by an upper row is the amount of exposure. Where two siding ends meet, a spline or caulking closes the joint to make it watertight.

In addition to horizontal applications, wood lap siding can also be applied vertically. In board-and-batten construction, board siding is attached vertically to the exterior wall sheathing and the joints are covered with narrow wood strips known as battens. Vertical siding may also be overlapped alternately without battens. Shiplap siding can also be applied vertically.

Wood lap siding may also be applied at an angle to create the desired effect. The angle may be 45°, parallel with the slope of the roof, or any other angle as determined by the architect. Lap siding applied at an angle is installed similarly to horizontal lap siding, from the bottom of the wall toward the top with each course overlapping the previous course.

Lap siding appears on elevations as a series of parallel object lines showing the edges of the siding pieces. The orientation of the object lines indicates the horizontal, vertical, or angular method of application. A notation identifies the type of siding material, width of the siding, and the amount of exposure.

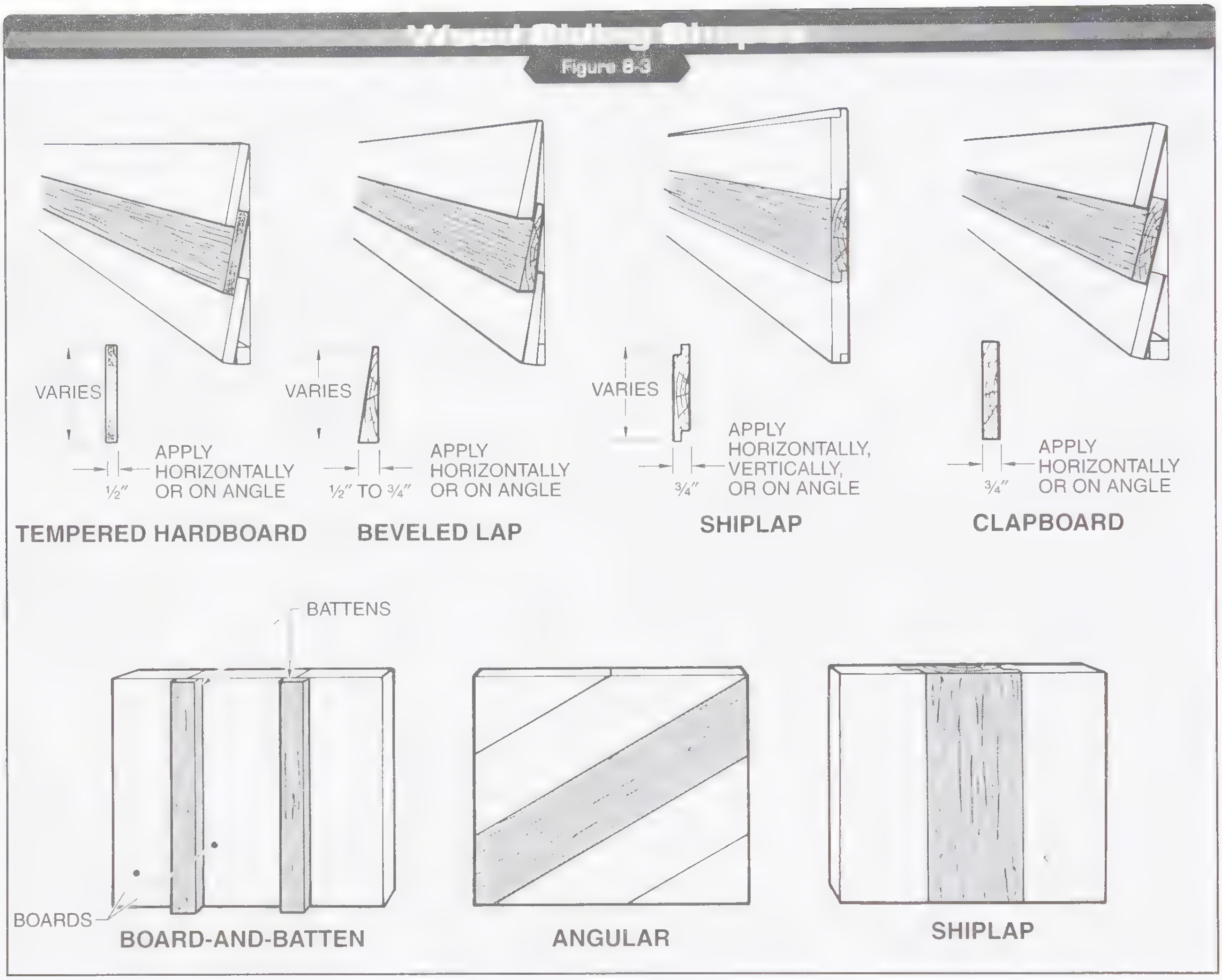

Figure 8-3. Wood siding is manufactured as hardboard or lumber and is available in a variety of shapes and finishes.

Panel Siding. Panel siding is available in 11⁄32″ to 5⁄8″ thicknesses, 4′ widths, and 7′ to 12′ long panels. Panels are made of either tempered hardboard or plywood with a special grade of adhesive and face veneer.

Hardboard panel siding provides a variety of exterior appearances with fewer joints than lap siding. Sheets are smooth or patterned to simulate wood grain with grooves, rough sawn wood, stucco, and other patterns. See Figure 8-4. Panel edges are designed and manufactured to overlap each other on the long sides. Hardboard panel siding has a coat of primer paint applied during manufacture and requires finish painting after application.

Plywood panels are manufactured with an exterior glue and are marked as an exterior grade. Plywood panel siding has a face veneer of cedar or other water-resistant wood. The face veneer is smooth or grooved to provide a reverse board-and-batten appearance. The veneer finish is typically rough sawn, providing a rustic appearance. Plywood panel siding may be painted, stained, or allowed to weather naturally.

Panel siding is applied to exterior walls with the 4′ dimension placed in a horizontal direction and the long dimension in a vertical direction. Patterns on the panel are designed for this method of application. Where high walls require panel siding to be placed one panel above the other, a piece of aluminum flashing (either Z- or S-channel) is attached to the wall to lap over the lower row of panels. The upper row of panels is installed over the flashing. Proper flashing installation prevents surface water running down the upper panels from running behind the lower panels. Panel siding is also cut for installation as a soffit covering.

Elevations show the type of panel siding with notations from the architect. Elevations indicate the pattern of the panel siding and may also include the manufacturer's identification name and number.

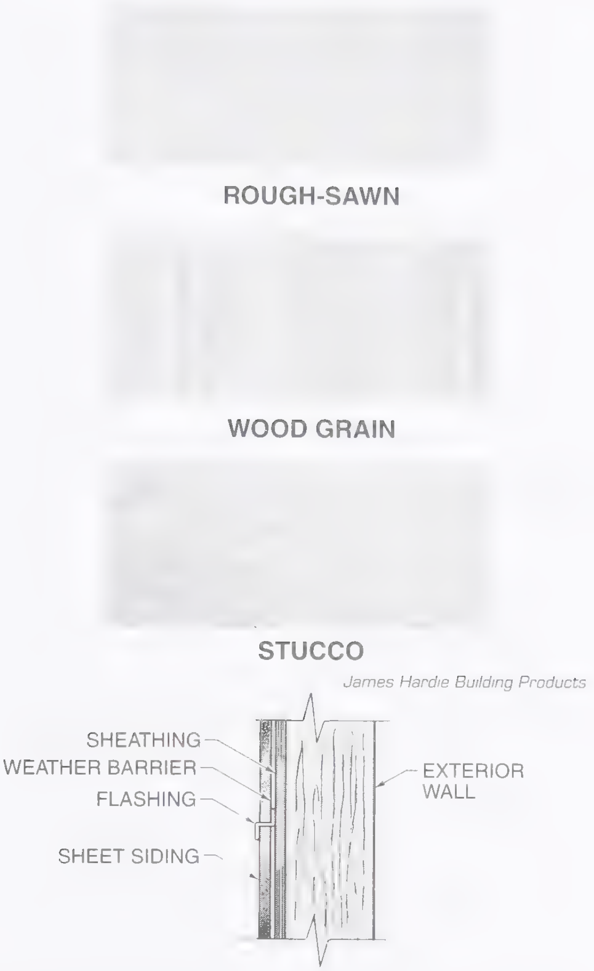

Figure 8-4. Large panels of wood siding are manufactured in a variety of finishes.

Shingles and Shakes. Wood shingles and shakes are made of red cedar, which is a weather-resistant wood. See Figure 8-5. Wood shingles and shakes are made by cutting logs to certain lengths and sawing or splitting the sections lengthwise into narrow pieces. Shingles are sawn from the sections and shakes are split from the sections, providing shingles with a smoother face than shakes. Shakes provide a more rustic appearance. Wood shingles and shakes are flat or tapered in thickness from approximately 1¼″ at the bottom to ½″ at the top. Shakes and shingles are available in random widths ranging from 3″ to 14″ and in standard lengths of 16″, 18″, 24″, and 32″.

Exterior wall sheathing is covered with a weather barrier or asphalt-impregnated building paper before shingles or shakes are applied to prevent wind and moisture infiltration. Shingles and shakes are applied to the exterior walls in rows starting at the bottom. Each piece is applied separately, with successive shingles or shakes in successive courses arranged so as to cover horizontal and vertical joints of the previous course.

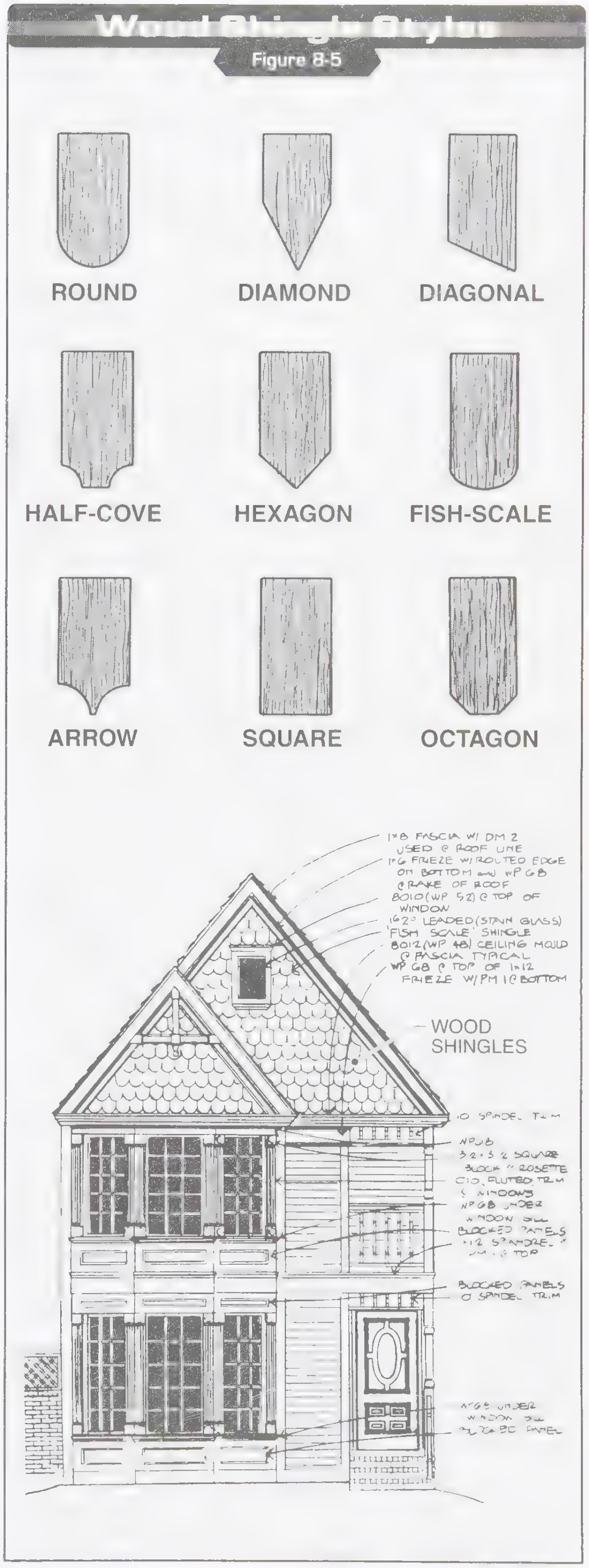

Figure 8-5. Shingles are available in a variety of shapes, which are shown on elevations.

Shake or shingle panels are available in 8′ lengths to provide more efficient installation yet retain the appearance of individual shingles or shakes. The panels are applied in the same manner as horizontal lap siding. Shingles and shakes are shown on exterior elevations with architectural notations and shingle symbols indicated on the appropriate section of the wall.

Trim Members. Wood is milled into various shapes and sizes for use as trim members. See Figure 8-6. Brick mold is 1″ to 1½″ thick, 2″ wide, and 8′ to 16′ long. Brick mold is installed where wood siding and masonry meet or at the joints between windows, doors, and exterior wallcoverings. The brick mold provides a surface for caulking joints between various exterior finish members.

A drip cap, also known as a water table, is approximately 1⅝″ × 1¹⁄₁₆″ and is installed with the downward slope on the top and the notch along the bottom. The downward slope forces water away from the house and the notch at the bottom forces water to drip off the trim and away from the siding.

Shingle mold is a decorative trim member that is attached below the soffit overhang. Dentil mold is cut with notches to form a serrated edge. Other various wood trim members are applied to create decorative panels and designs.

Notations on exterior elevations indicate trim member types and locations. The architect may specify trim members by referring to manufacturers' or suppliers' identification numbers.

Western red cedar is a durable exterior finish material due to natural chemicals in the wood.

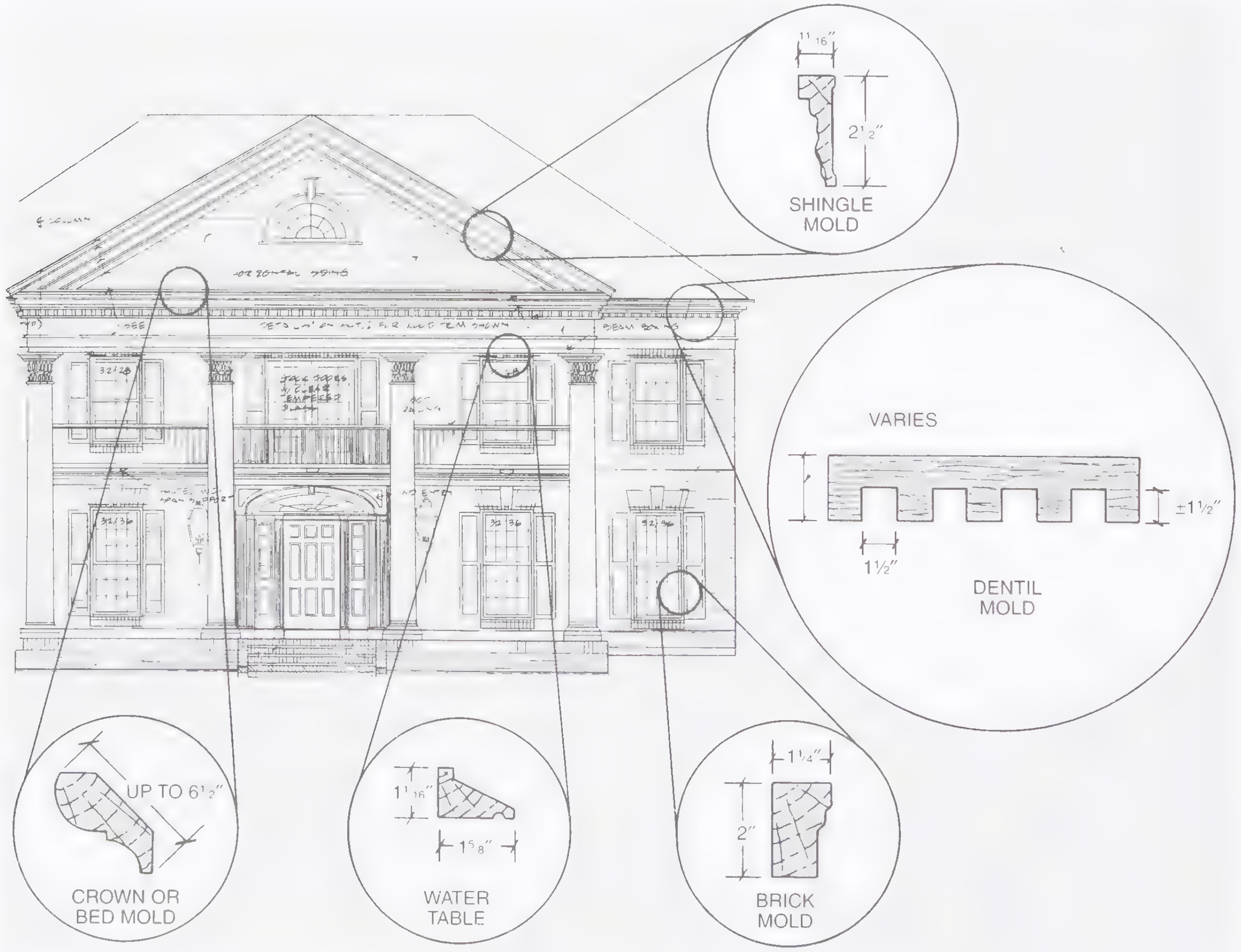

Figure 8-6. Wood trim members cover the joints between exterior finish materials and create various decorative finishes.

Fiber Cement Siding

Fiber cement board is an exterior finish material that provides the appearance of wood siding. Fiber cement siding is precolored with the color penetrating the entire thickness of the siding. Fiber cement siding is a highly stable product that does not warp or twist, has excellent fireproofing properties, and is resistant to impact damage.

Styles. Fiber cement siding is available for horizontal and vertical applications. Horizontal lap siding is manufactured in 5¼″, 6¼″, 8¼″, 9½″, and 12″ widths with either a smooth or wood grain texture. See Figure 8-7. Shingle panels in 6″, 8″, and 12″ widths are also available. For vertical application, fiber cement panels are available in 4′ widths and 8′, 9′, and 10′ lengths with either smooth or wood grain finish.

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Figure 8-7. Fiber cement siding has the appearance of wood siding, but provides greater durability.

Fiber cement planks are also available for edge and trim members. The planks are available in thicknesses of 7⁄16″, ¾″, and 1″ thicknesses, 4″, 6″, 8″, and 12″ widths, and 10′ and 12′ lengths with a smooth wood grain finish.

Installation. Fiber cement siding may be fastened directly to wall framing or to the wall sheathing. Horizontal application of fiber cement lap siding is similar to wood lap siding, working up from the bottom of the wall toward the top. The course exposure is noted on the elevations. Fiber cement siding is fastened to the wall surface with galvanized nails or screws similar to wood siding. Planks are applied to edges and corners using nails.

Fiber cement panel siding is applied in a manner similar to wood panel exterior siding. Fiber cement board siding is finished with exterior paint to ensure proper weather resistance. Fiber cement board panels and planks are also utilized for soffit and fascia finish.

Fiber cement siding is noted on the exterior elevations with an architectural notation. Symbols indicate the type and style of siding and finish.

Metal, Vinyl, and Polymer Siding and Trim

Metal and vinyl exterior siding provide the appearance of horizontal lap and vertical wood siding and require less maintenance than other types of exterior siding material. See Figure 8-8. Metal siding is made of aluminum or prepainted steel.

Metal or vinyl siding does not require painting and has good insulation qualities. Smooth finishes or various wood grain textures are available in a variety of colors. Siding components lock together with grooves and notches that are part of the siding design. Metal and vinyl trim members complete the exterior finish.

High-density polymer materials are used as exterior trim members. The polymer material is cast into various shapes, such as dentil or brick mold. High-density polymer materials are lightweight, weather-resistant, and paintable. The trim members are applied with nails or adhesive. Where utilized, an architect will typically identify the trim members with a manufacturer's name and product number.

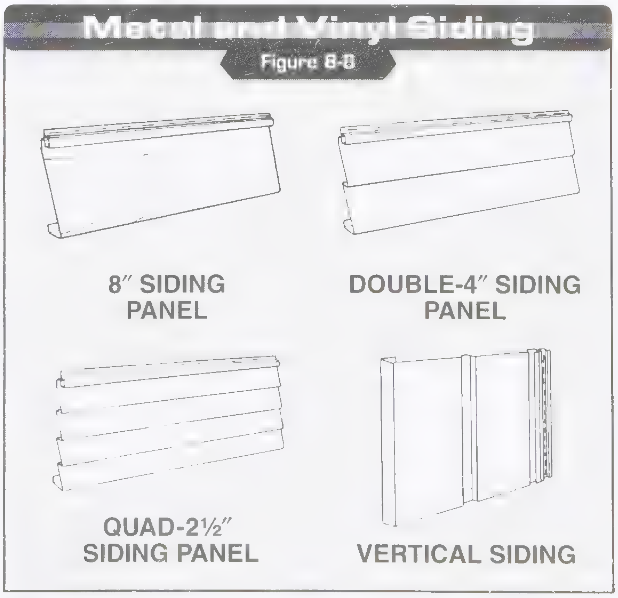


Figure 8-8. Interlocking siding covers exterior walls and may be embossed to simulate wood grain.

Interlocking Lap Siding. Metal and vinyl lap siding has an approximately 1/16″ thickness, 8″, 10″, or 12″ widths, and standard 12′-6″ lengths. Each piece of siding has a lip at the bottom that locks into the lower row of siding and a groove at the top to interlock the upper row. Metal and vinyl lap siding may have one or several horizontal offsets in the face to make one wide piece appear as several narrower pieces.

As with wood siding, a weather barrier or asphalt-impregnated building paper is fastened to the exterior sheathing to provide additional wind and thermal protection. A starter strip applied at the bottom of the wall provides the first interlock. With some types of siding, expanded foam sheets are inserted into the back of each course of siding to provide insulating properties and to provide support for greater dent and break resistance. Siding is attached to the wall, beginning at the base, by nailing it into a row of slots above the upper interlocking groove.

Vinyl sheets are also available that provide the appearance of brick, stone, and wood shingles. The vinyl sheets are approximately 24″ square and interlock along all four edges.

Metal and vinyl lap siding is shown on exterior elevations in the same manner as other lap siding, with an architectural notation indicating the type of material.

Trim Members. In addition to starter strips, other metal, vinyl, and polymer trim members are utilized in residential construction. A J-channel is installed vertically and horizontally around windows and doors to enclose the ends of siding. Drip caps installed above windows and doors prevent surface water from entering the house. A T-channel or H-channel covers and supports joints between adjoining pieces of material.

Trim members are installed at corners, around window and door openings, and at the junction between exterior walls and the roof.

Inside and outside corner posts are attached vertically to corners before siding is installed. The inside and outside corners provide a finished appearance by enclosing the ends of siding.

Metal, vinyl, or polymer fascia covers enclose wood fascia boards at the ends of the rafters. A wall molding or frieze runner is attached to the wall level with the bottom edge of the fascia cover to support interlocking soffit pieces.

Soffit. Metal, vinyl, or polymer interlocking soffits are available to cover the soffit area. See Figure 8-9. The soffit sheets measure 12″ wide by 12′ long and are approximately 1/16″ thick. Grooves in the soffit pieces increase strength and improve appearance.

Soffit sheets are vented or solid. Vented and solid soffit sheets are alternated during installation to provide proper attic ventilation. Solid soffit sheets may also be applied as vertical siding on exterior walls.

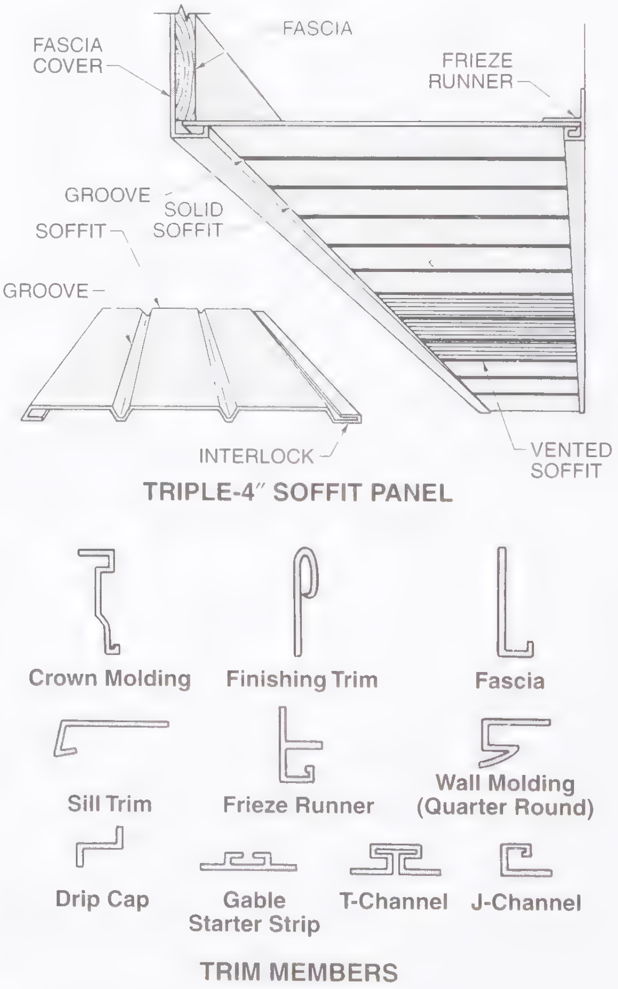


***Figure 8-9.** Metal and vinyl soffit coverings provide maintenance-free alternatives to wood products.*

Masonry

Masonry is a durable and maintenance-free exterior finish material. Masonry does not require painting, and when properly maintained, weather damage to masonry is minimal. Masonry materials used for exterior finish include brick, concrete masonry units, stone, and concrete.

Where masonry is applied as a veneer to the outside of wood-framed walls, the masonry is held away from the wood framing members to create an air space approximately 1″ wide. The air space reduces thermal transmission and moisture into the house.

Brick. Many different types and styles of exterior finish brick are available. A wide range of colors is available in either smooth or rough textures. Face brick is the most common type of exterior finish brick. The standard size for face brick is 4″ wide by 8″ long by 2⅔″ thick. Face brick is manufactured with vertical holes through the brick for installation of reinforcement if specified.

Bricks are laid in a variety of bonds, or patterns. See Figure 8-10. Special courses of brick are laid as sills and headers at window and door openings and at the tops of walls. A steel or stone lintel set at the top of each opening supports the masonry above the opening.

Brick and other masonry units are laid when air temperatures are sufficient to prevent the freezing of the mortar that secures the masonry units together. Freezing prevents proper hydration of the mortar ingredients, producing low-strength mortar. Masonry wall corners are laid first to provide reference points. Strings stretched between the corners act as guides in keeping the brick courses straight. Spirit levels are used to plumb masonry walls.

The vertical spacing of brick courses is calculated with a mason's ruler. A mason's ruler is divided into courses of brick, varying with the thickness of the mortar joints. The thickness of mortar joints is adjusted to meet the overall height dimension. Mortar joints are approximately ⅜″ to ½″ wide. Mortar joints may be concave, V-joint, weathered, flush, struck, or raked.

Brick walls are shown on exterior elevations as a pattern of close horizontal lines, either solid or broken, and with an architectural notation.

Concrete Masonry Units. Concrete masonry unit (CMU) walls are durable and the cost of CMUs is less than bricks. Many exterior finishes are available for CMUs, including smooth, rough, and grooved faces. Five basic types of CMUs are hollow load-bearing, solid load-bearing, hollow non-load-bearing, concrete building tile, and concrete brick. Hollow load-bearing CMUs measuring 8″ × 8″ × 16″ are the most common CMUs used in residential construction. The cores of the CMUs may be filled with a material such as expanded foam to increase the insulation effectiveness.

The procedure for laying CMUs is similar to the procedure for laying a brick wall. CMUs are rarely used as a masonry veneer material.

CMU foundation walls are shown on exterior elevations where the foundation projects above ground level. CMUs appear on exterior elevations as a pattern of rectangles with architectural notations.

Stone. A rustic appearance is achieved when stone is used as a foundation, veneer, or exterior wall material. Irregular-shaped stone is typically not set in courses; rather, the stone is laid randomly. Rectangular stone is laid in bonds. Solid pieces of stone are set over window and door openings for lintels or keystones. In some cases, door sills or windowsills may be specified below doors and windows. Stone is noted on exterior elevations by the architect.

Concrete. Concrete is not used as an exterior veneer material. Concrete is shown on elevations as a foundation material or if the exterior walls are concrete. Patterned forms and form liners may be used when placing wall forms to create different finishes on exterior concrete walls. The concrete wall patterns are shown on exterior elevations.

Lath and Plaster

Lath is fastened to framed or masonry walls as a base for plaster and to prevent plaster cracks. Various types of metal lath are available for exterior application of plaster. Stucco, which is a type of plaster, is an exterior finish material popular in warm climates. Stucco is made of sand, water, cement, and lime. Color can be added directly to the mixture before stucco is applied. Stucco allows for easier construction of geometric shapes.

After lath is installed, plaster is mixed and applied in several coats with a trowel, or applied to the framed wall by shooting the plaster through a large hose. Plaster can be applied directly to masonry. The final finish of the plaster, smooth or textured, is noted on the elevations. Details may also be provided. See Figure 8-11.

Wire Lath. Types of wire lath used in residential construction include square wire mesh, poultry netting woven into hexagons, and expanded metal lath. Wire lath is installed over a layer of asphalt-saturated felt building paper and/or sheathing applied to framing members. Wire lath is held at least ¼″ away from the face of the wall to allow the plaster to form a solid bond around the lath.

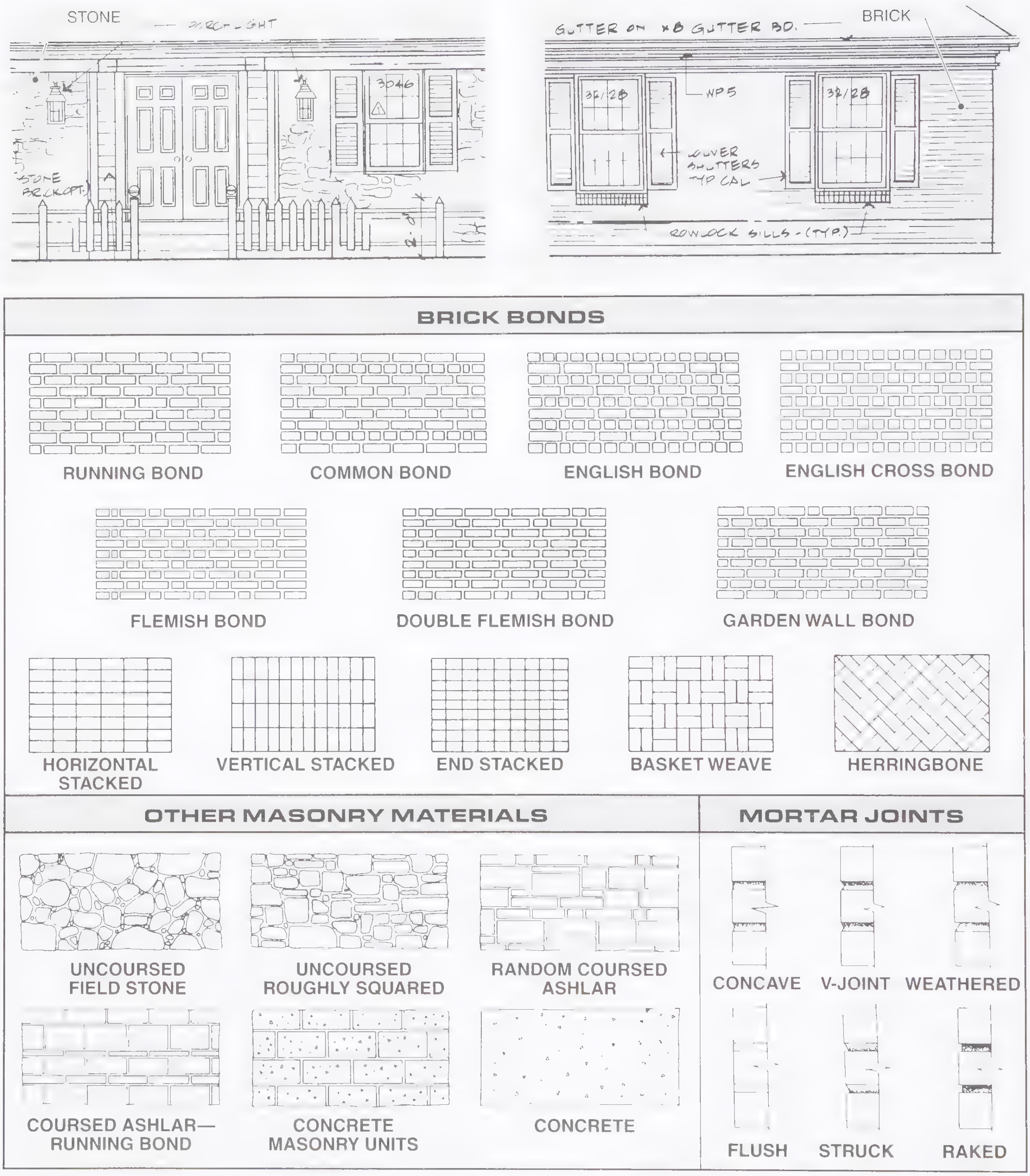


Figure 8-10. Masonry materials are indicated on elevations using various symbols.

The term "plaster" is derived from the Greek word "emplastron," which means "to daub on."

Paperbacked Lath. Paperbacked lath is lath with the backing paper and wire manufactured as one unit. Paperbacked lath is attached to walls in the same manner as wire lath and creates an application surface for the plaster.

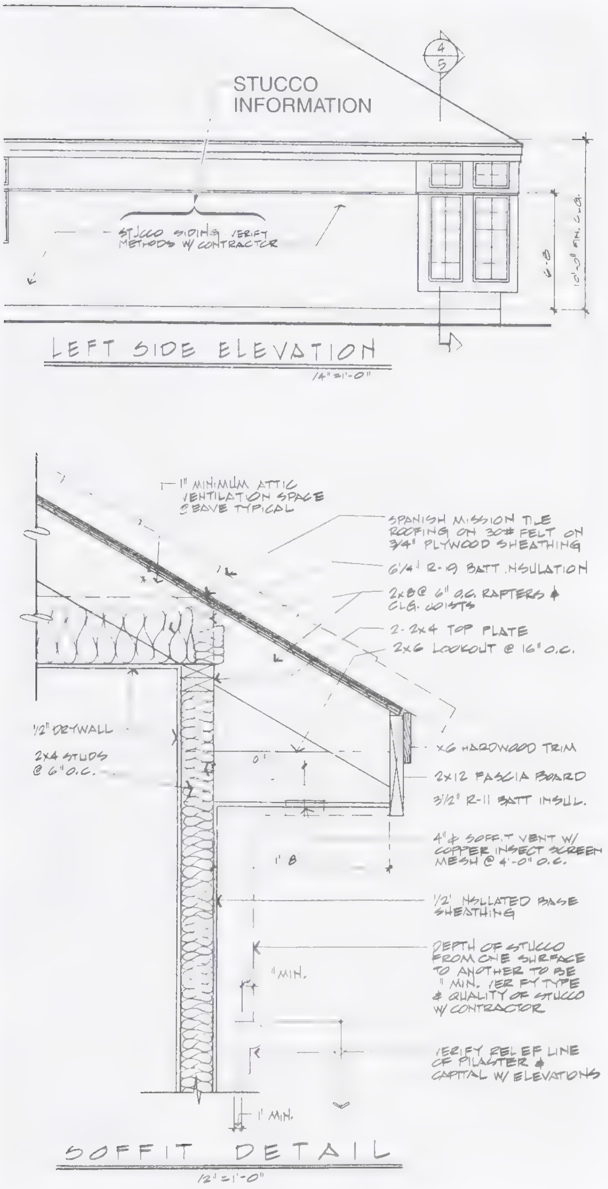


Figure 8-11. Information regarding stucco application is indicated on elevations and may also be included in details.

Exterior Insulation and Finish Systems

An exterior insulation and finish system (EIFS) is an exterior finish consisting of insulation panels, reinforcing mesh, and a base coat and finish coat of acrylic resins. Insulation panels are molded or extruded from expanded polystyrene or polyisocyanurate. The panels are cut with a utility or hot knife and are easily shaped to various forms such as arches and other geometric shapes. Joints in the insulation panels are staggered when applied to the exterior wall face. Insulation boards are attached to the exterior face of the wall sheathing with mechanical fasteners, such as screws or nails, and/or an adhesive.

Metal flashing and sealant is critical to the proper installation of EIFS. Flashing and sealant is typically required around all door and window openings and at the junction of the top of the wall and roof soffits. The base coat is troweled onto the face of the insulation panels. A fiberglass or plastic reinforcing mesh is set into the freshly applied base coat. After the base coat has properly set, the finish coat is applied. The finish coat may include polymer modifiers to affect the setting time and other characteristics of the finish coat. The thicknesses of the base coat and finish coat are based on the manufacturer's written specifications.

Elevations indicate any geometric features, accessories such as J-channels, and expansion and control joints. Additional information regarding the insulation panels and means for attaching the panels to the exterior wall sheathing are shown on a typical wall section or detail.

EXTERIOR OPENINGS

Exterior wall openings appear on exterior elevations. Exterior elevations are the primary source of information about the types of doors, windows, and louver vents that are to be installed. Doors, windows, and vents are shown with various symbols and architectural notations.

Doors

Elevations show door type using orthographic projections of the door. Doors shown on elevations include flush, panel, sliding, and overhead (garage). See Figure 8-12.

Pella Corporation

Sidelights and transoms may be used in conjunction with main entrance doors to create a dramatic effect.

Building codes require minimum thickness, width, and height for exterior swinging doors. Exterior swinging doors are approximately 1¾″ thick, depending on the material from which the door is manufactured. Some steel exterior swinging doors are 1⅜″ thick. Per the *International Residential Code*, the minimum width for a single exterior swinging door is 36″ and the minimum height is 6′-8″. At least one door conforming to these minimum dimensions is required in a house. The door shall provide direct exit to the exterior of the house without traveling through the garage. A floor or landing must be provided on each side of the door. All exterior doors must be readily openable from the inside of the house without the use of a key or special knowledge. See Figure 8-13. Always refer to the building code in effect in your jurisdiction for door requirements in your particular area.

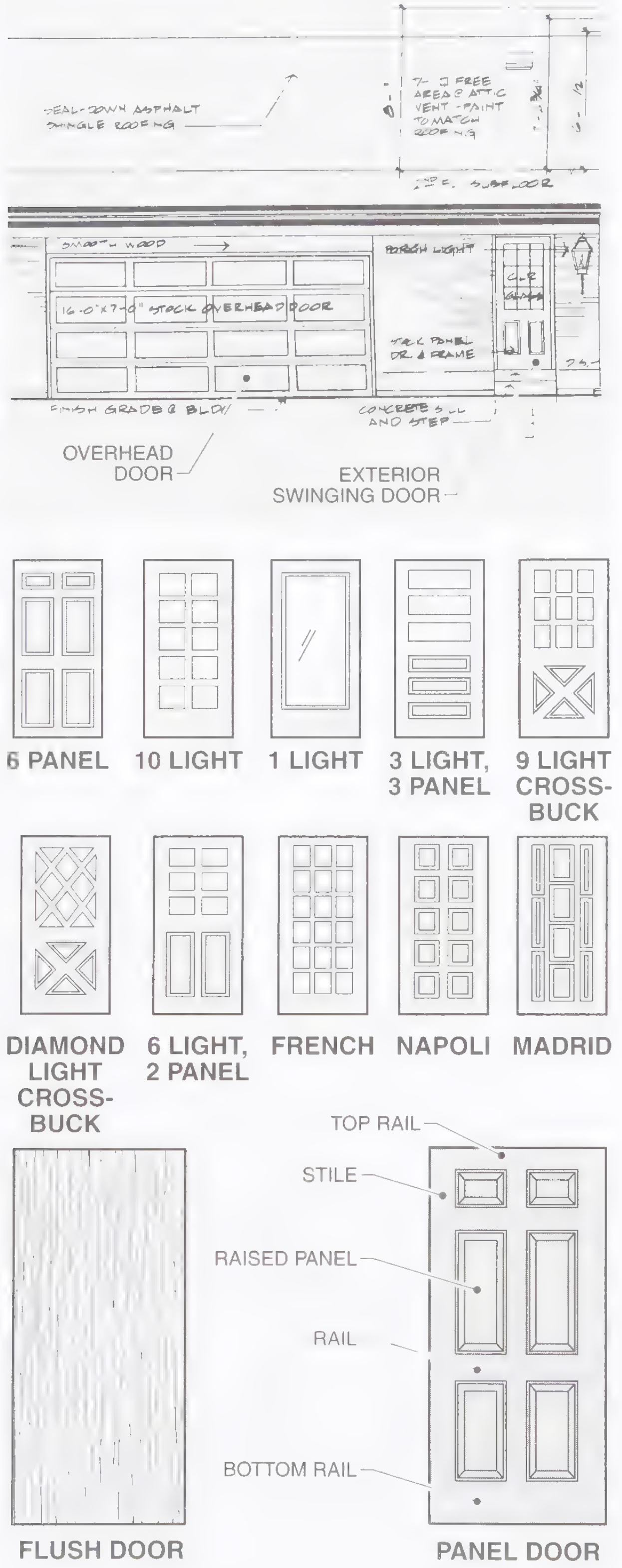


Figure 8-12. Exterior doors, including overhead doors, are shown on elevations.

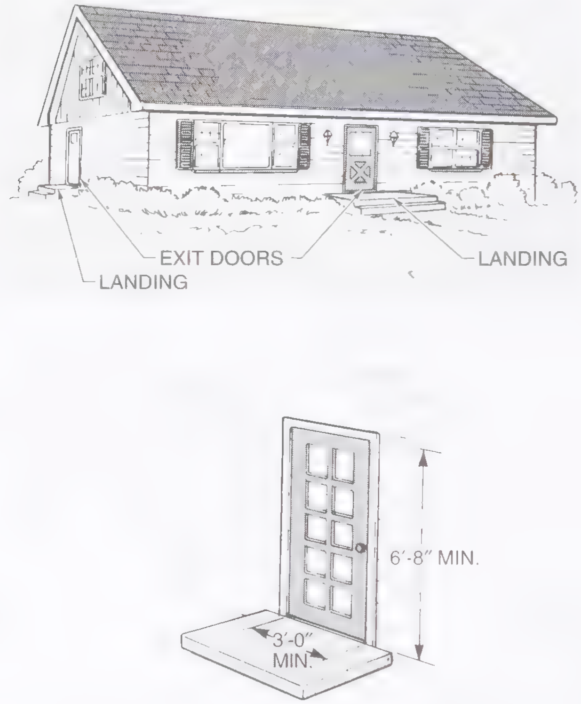


Figure 8-13. Local building codes specify minimum height and width requirements for exterior swinging doors.

Exterior swinging doors are made of wood, metal, or fiberglass composite materials. Wood exterior doors have a solid core. Metal and fiberglass composite exterior doors are filled with expanded foam to provide additional insulation. All exterior doors must meet design pressure ratings according to the local building code requirements.

Exterior swinging doors are installed as prefabricated, or prehung, units. Prehung doors are delivered to the job site with the jamb, exterior trim, and hinges in place and ready for installation as one unit. Prehung doors reduce on-the-job labor costs associated with door installation.

Exterior swinging doors are hung with three hinges mounted on one side of the door and attached to the jamb. Where two swinging doors are installed in the same jamb to create a wide opening, an astragal (T-shaped decorative trim member) is attached to one of the doors at the meeting point to close the joint. The most common types of exterior swinging doors are flush doors and panel doors.

Flush Doors. Flush doors have a flat surface on each face. Trim members, decorative moldings, and glass may be added into the design of flush doors to give them an attractive appearance. Glass installed in an exterior door is called a light.

Panel Doors. Panel doors are composed of stiles (vertical frame members), rails (horizontal frame members), and panels (areas between stiles and rails). A six-panel door is the most common panel door.

Another popular style of panel door is the crossbuck door. It consists of a lower section and an upper section. In the bottom section, the stile, rail, and angled panel configuration creates four triangular areas. Several lights are installed in the upper section of a crossbuck door.

Trim. Pilasters and pediments at doors provide a decorative finish. See Figure 8-14. Pilasters are installed at either side of the door and are grooved or covered with other ornamentation. Pediments over doors are available in several designs. Pilasters and pediments are indicated on exterior elevations using orthographic projections.

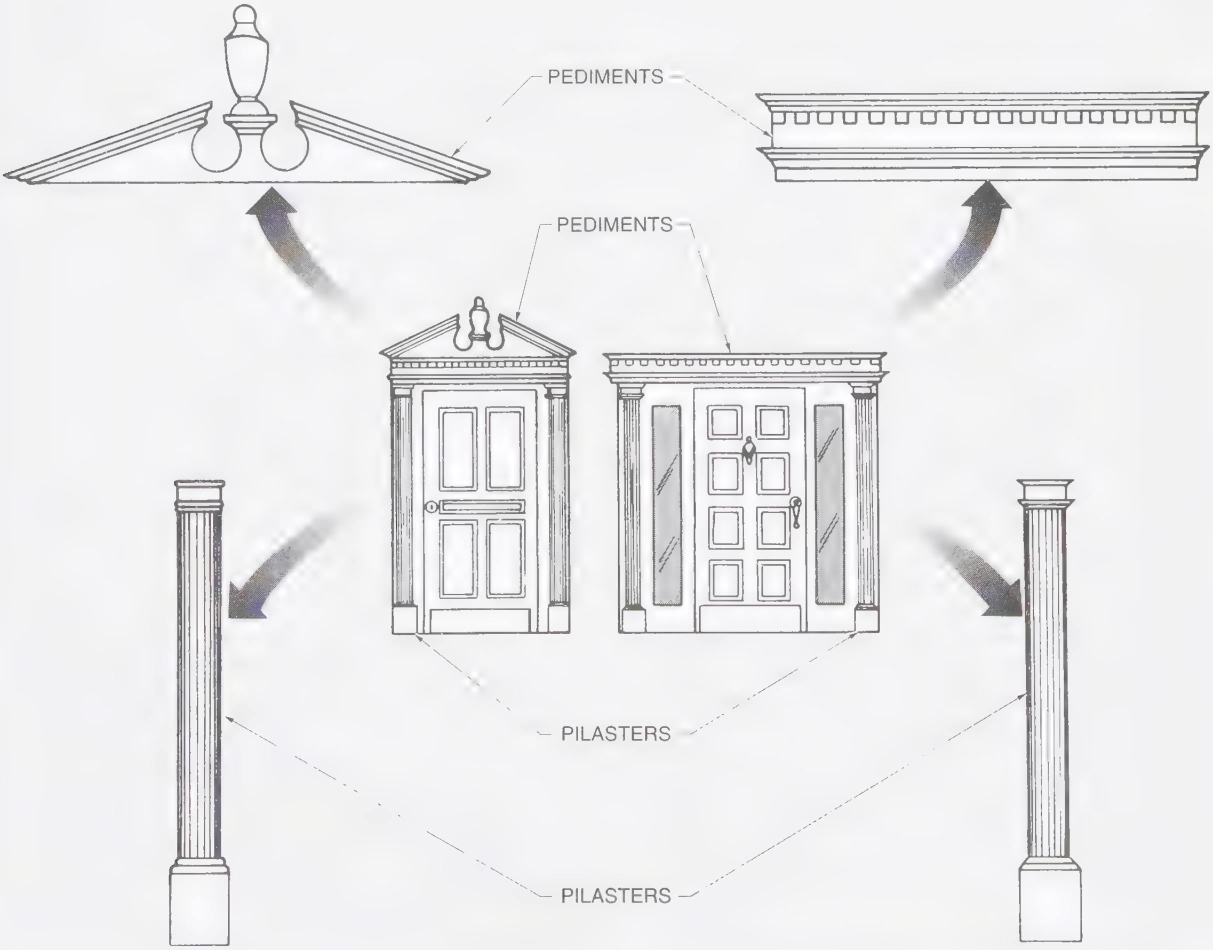


Figure 8-14. Pediments are placed over the door and pilasters as ornamentation.

Tempered glass is required in sliding glass doors, entrance doors, sidelights, and at other potentially hazardous locations. Tempered glass is significantly stronger than most other types of glass, has a high resistance to thermal stress, and has high impact resistance.

Sliding Glass Doors. Sliding glass doors, also known as patio doors, move horizontally on rollers built into the bottom of the door frames. The doors are constructed with wood or aluminum frames that hold the glass in place. Tempered glass is required in sliding glass doors, and it may also be insulated. Jambs for sliding glass doors have two tracks that allow one door to slide horizontally past the other.

Sliding glass doors are installed in groups of two or more with one movable door and one fixed door (not movable). A horizontal arrow on elevations indicates the movable door and travel direction. Sliding glass doors are shown on exterior elevations with an architectural notation that describes the material used for the frame and the type of glass. See Figure 8-15.

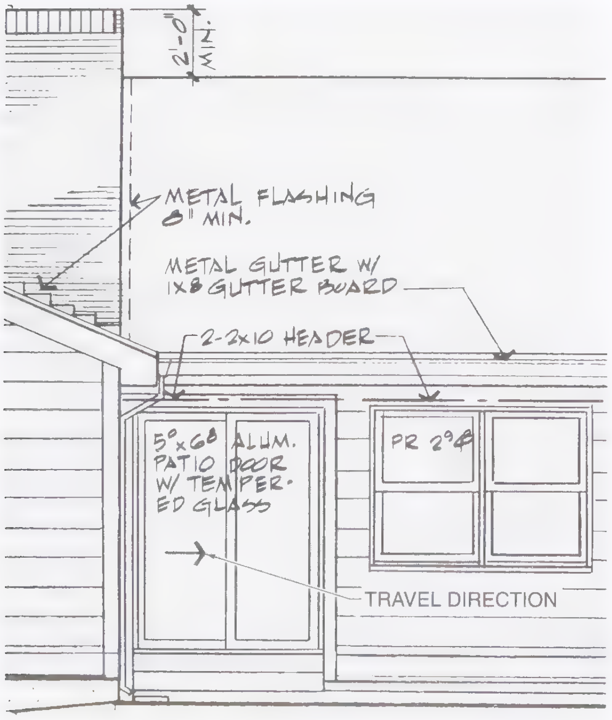


Figure 8-15. Sliding glass doors have wood or metal frames and slide horizontally in a track.

Overhead Doors. Overhead doors, also known as garage doors, are wood, metal, or fiberglass panel or flush doors. See Figure 8-16. Lights may be incorporated into the garage door design. Overhead doors have a series of hinges and rollers on the inside of the door that allows them to be raised and lowered in a track with the help of springs. Standard residential overhead doors are made in four horizontal sections, with each section being 21″ high. Overhead door sizes appear on exterior elevations and are typically 7′-0″ high and vary in width from 8′-0″ to 16′-0″.

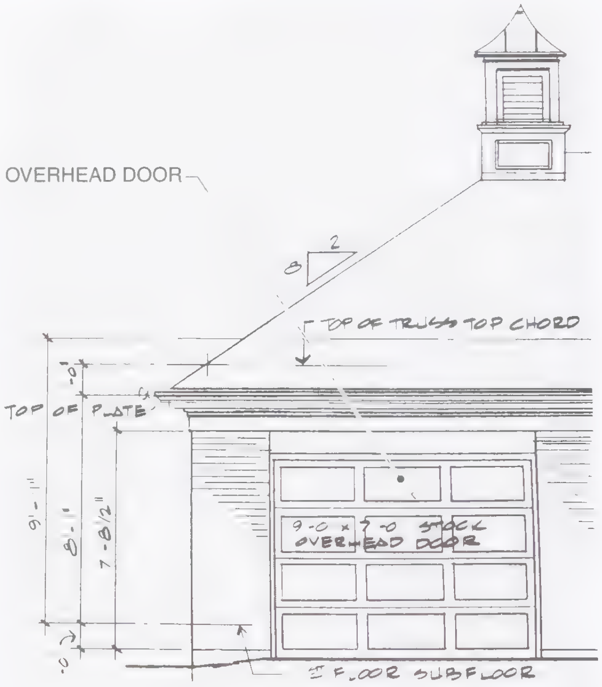


Figure 8-16. Overhead doors travel vertically using a system of springs and tracks. Automatic electric garage door openers can be installed to raise and lower an overhead door.

Windows

Elevations provide information about the sizes and types of windows installed in exterior walls and skylights in the roof. Orthographic projection is used to show each type of window. See Figure 8-17. Horizontal locations for placement of windows are shown on the floor plan in a set of residential prints.

Single-strength glass, tempered glass, insulated glass, and glass block are used in window construction. Window frames are aluminum, steel, wood, or vinyl-covered wood. Plastic is the common material for skylight construction.

Windows are manufactured and delivered to the job site as prefabricated units. The prefabricated units are set into framed openings in the exterior walls.

There are several standard window and window frame components. See Figure 8-18. The sill is the lowest horizontal section of the window frame. Similar to doors, the vertical members of the window frame are the stiles and the horizontal members are the rails. Several glass panes installed in one frame are separated by members called muntins.

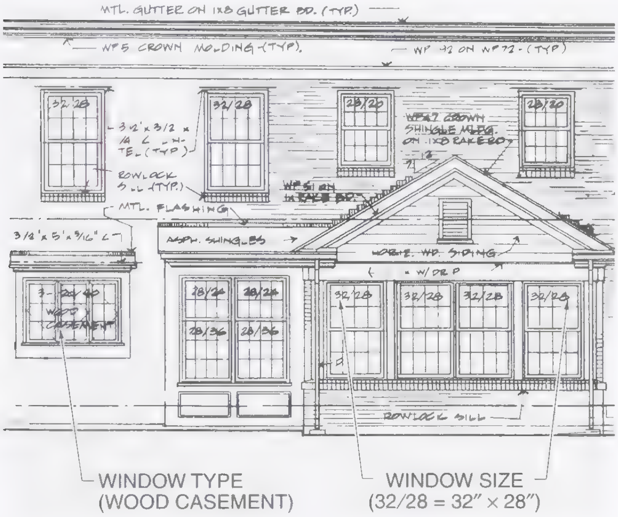


Figure 8-17. Elevations show exterior windows. Window sizes are noted over the windows.

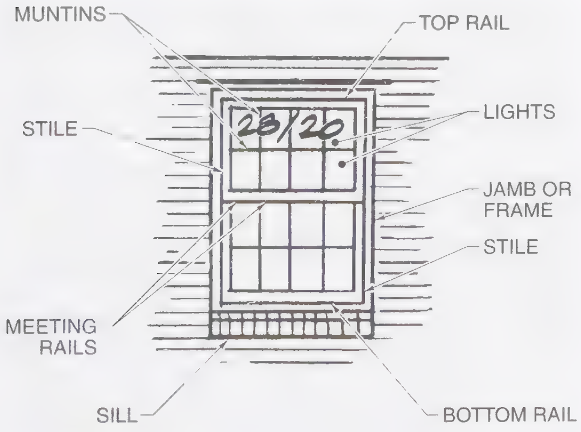


Figure 8-18. Various types of windows have the same basic components.

Window size is indicated on exterior elevations by the size of the light (glass). Glass sizes are expressed in inches with the width appearing first, followed by the height. The two dimensions are typically separated by a slash. A window noted on an elevation as 32/28 has a light that is 32″ wide and 28″ high. The window size is typically shown on an elevation in the glass area of the window.

A window that does not open is a fixed window, or fixed-glass window. Other windows are single- or double-hung, sliding, casement, hopper, awning, bay, bow, jalousie, and skylight. See Figure 8-19.

Fixed-Glass Windows. Fixed-glass windows are made of one piece of glass or glass blocks. The piece of glass is set in a frame with wood, metal, or plastic trim to hold the glass in place. Glass block windows are installed in a manner similar to installing brick or concrete masonry units in walls.

Single-Hung Windows. Single-hung windows have one fixed window (usually the top window) and one vertical sliding window. Springs or weights are attached to the lower unit to allow the window to be opened and closed easily.

Double-Hung Windows. Double-hung windows are the most common type of window in residential construction. Double-hung windows consist of two window units that slide up and down. The units pass each other and allow either the upper or lower half of the window to be open. Double-hung window sizes are shown on exterior elevations.

Sliding Windows. Sliding windows are similar in design to double-hung windows, but they move in a horizontal direction. Rollers are mounted to the bottom of sliding window frames to help them move easily in the tracks. Both windows may open, or one may be fixed. An arrow on the elevation indicates the travel direction for the sliding window. Sliding windows appear on exterior elevations as a vertical line with glass sizes noted.

CertainTeed Corporation

Sliding windows move horizontally in a track.

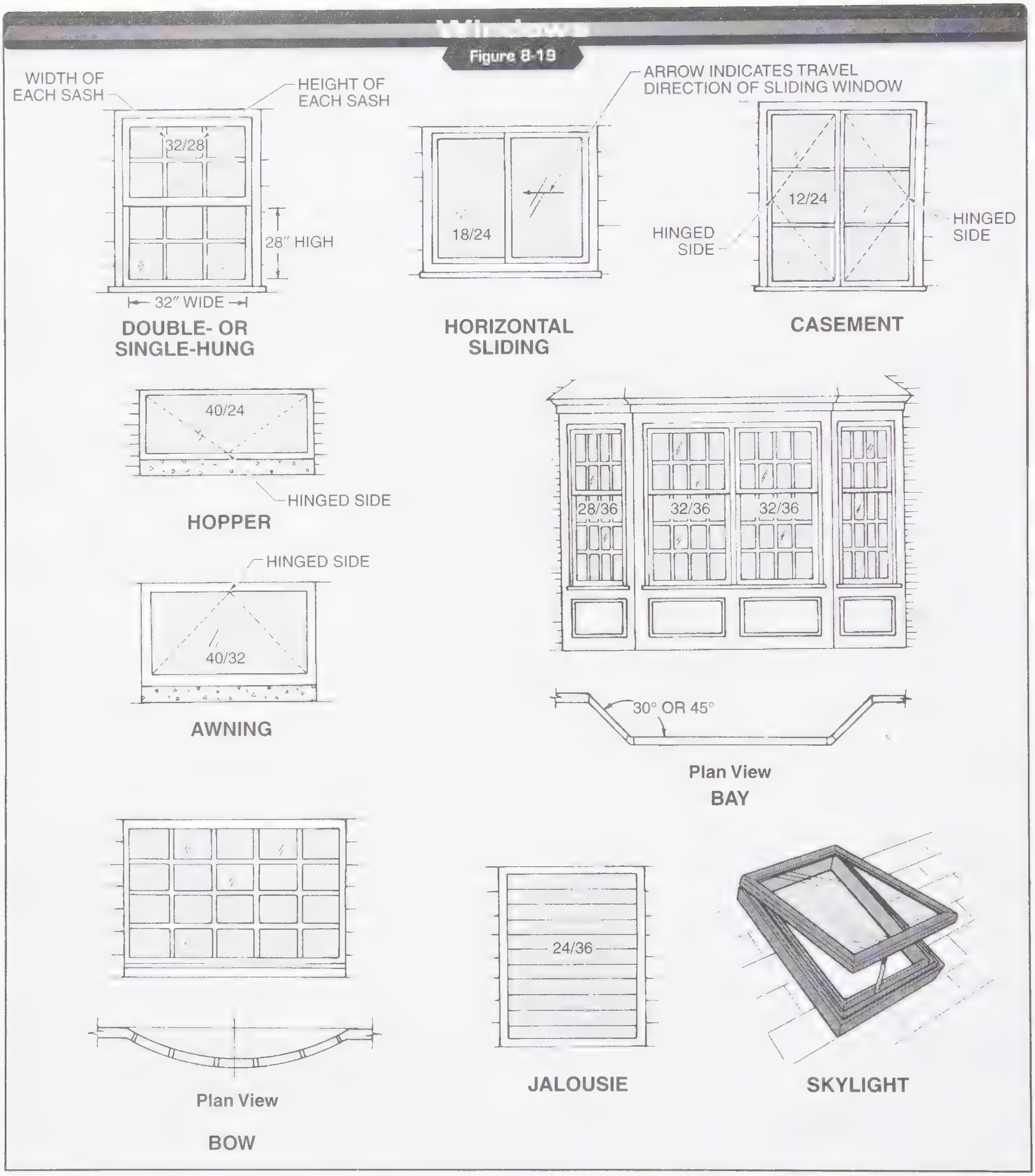


Figure 8-19. Hidden lines on swinging windows and arrows on sliding windows indicate the opening direction.

Casement Windows. Casement windows are hinged at one side and open in a manner similar to a swinging door. Casement windows open with an operator (crank-and-gear system) built into the jamb and attached to the frame. Hidden lines on exterior elevations converge on the side of the casement window that is hinged. Light sizes are also noted on the elevation.

Hopper Windows. Hopper windows are hinged at the bottom of the frame with the upper edge opening to provide ventilation. Hopper windows are often used

in below-grade areaways. Hidden lines on an exterior elevation converge at the bottom (hinged side) of a hopper window.

Awning Windows. Awning windows are hinged at the top and are shown with hidden lines intersecting at the top of the frame. Awning windows are particularly functional because they can remain slightly open during rain to provide ventilation.

Bay Windows. Several types of windows, such as double- or single-hung, casement, hopper, awning, or fixed-glass, may be joined together to form a bay window. Bay windows project out from the face of the wall at an angle and are particularly apparent in the floor plan. Two mullions secure the window units together at the desired angle, which is commonly 30° or 45°.

Bow Windows. Bow windows are constructed with more mullions than bay windows and hold smaller glass panels at a 5° angle to create a radius effect. Bow windows are commonly fixed-glass panels. Bow windows are also particularly apparent in a floor plan.

Both bay and bow windows require special framing and finishes above and below the windows. The window size is shown on exterior elevations.

Jalousie Windows. Jalousie windows are made of narrow glass panes mounted horizontally in a frame. All the glass panes are controlled by one opening mechanism. Openings created at the horizontal seams where the glass panes meet limit the energy efficiency of jalousie windows. Jalousie windows appear on elevations as a series of horizontal lines. One light size is indicated for the entire window.

Andersen Corporation

Skylights are set into openings in a roof and allow natural light to enter the house.

Skylights. Skylights are set onto openings in the roof. Skylights may be fixed, or they may be hinged for opening. Skylights are set flush with the roof or mounted slightly above the roof on an elevated frame to prevent leaks. Due to the angle of the roof on exterior elevations, a direct orthographic projection of skylights is not shown. Skylight size is indicated in an architectural notation.

Vents

Openings in the exterior walls and soffits allow air to flow through unheated and uncooled areas to prevent condensation from forming in these areas. See Figure 8-20. Proper ventilation allows excessive heat to escape and helps cool the living areas during hot weather. The area of openings needed depends on the volume of the unheated and uncooled areas in the house.

Wall openings and soffits are covered with a variety of vents, also known as ventilators, to prevent moisture, insects, and animals from entering the house. Vents are made of aluminum, galvanized metal, wood, or plastic and have screening attached to the inside to keep out insects. Vents with horizontal slats are called louvers.

Activities of an average family of four generate approximately 22½ lb of water vapor in a 24-hr period. When the warm, moisture-laden air within a building comes into contact with cooler exterior surfaces of a building, the moisture comes out of the air and forms water droplets on cooler surfaces. This process is called condensation.

Vents are installed at the bottom of exterior walls to ventilate crawl spaces and at the top to ventilate attics. If the house has a gable roof, vents are installed in the gable ends. Houses with hip roofs ventilate the attic with vents placed in the underside of the soffit.

Rooftop vents provide additional air movement in the attic. Types of rooftop vents include flat, ridge, turbines, and power vents. The vents are designed to provide protection from rain, snow, or ice entering the attic. Screening is also installed to prevent insects and small animals from entering the house.

Flat roof vents project several inches above the roof finish and are square or round. Holes cut in the roof for flat vents are commonly 9″ to 12″ in diameter. Flat vents cover these holes and allow for natural air movement in the attic.

Vents

Figure 8-20

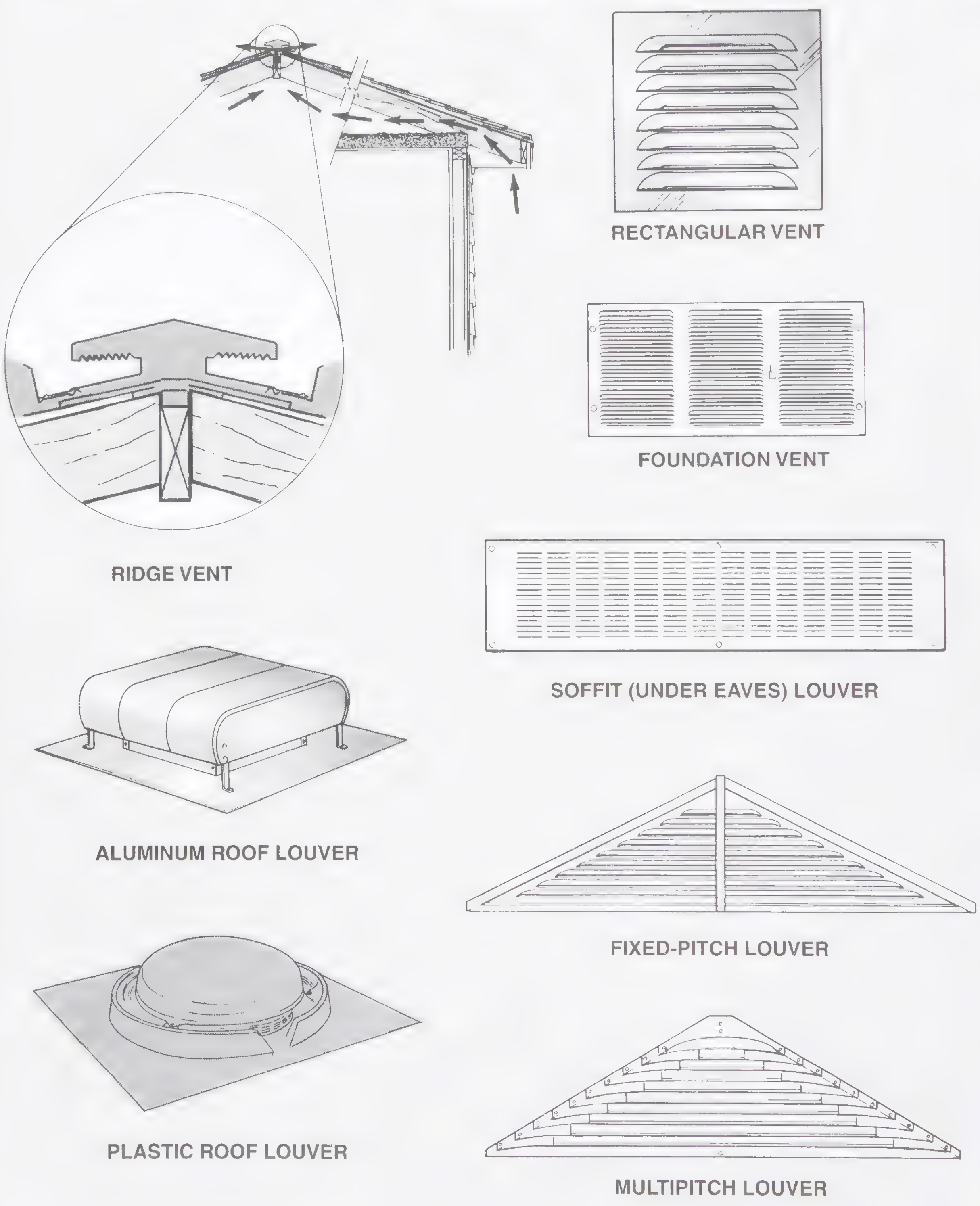


Figure 8-20. Vents are installed to provide air movement in enclosed areas.

Turbine vents actively move air out of the attic with a rotating motion. A circular-shaped vent has specially shaped fins (blades) that spin within a frame placed on top of a short vent pipe. Rising heat from the attic and outside winds contact the fins and turn the vent. The vent pipe is installed plumb with an adjustable section that allows for various roof pitches. Holes cut in the roof for turbine vents vary in diameter from 6″ to 30″, with 12″ being the most common size.

Power rooftop vents use an electric fan to move air out of the attic. The design of power vents is similar to flat roof vents, but they are somewhat larger. Holes cut in the roof for residential power rooftop vents vary from 11″ to 16″ in diameter. Power vent capacities vary from approximately 1000 cfm (cubic feet per minute) to 1600 cfm. The electric fan is controlled by a switch or a thermostat installed in the attic. Power vents can also be installed as gable-end louvered vents.

CertainTeed Corporation

Ridge vents, which allow for natural air movement in an attic, cover a continuous opening along the roof ridge.

Ridge vents cover a continuous opening along the entire ridge of the roof. Ridge vents may be sheet metal or a thick fabric installed over a gap in the roof sheathing. The ridge opening is approximately 3″ wide. Ridge vents allow for natural air movement.

Exterior vents are shown and noted on exterior elevations. The exact locations of the vents are determined at the job site according to the locations of the framing members.

Some exterior vents do not appear on exterior elevations. Vents required for plumbing systems project through the roof at a location convenient to the piping. Furnaces, clothes dryers, cooking stoves, bathroom fans, and range hoods are vented in exterior walls and the roof at appropriate locations determined during construction.

ROOF INFORMATION

The roof design is indicated on the elevations. See Figure 8-21. The front, back, and side views show the type (flat, shed, gable, hip, mansard, or gambrel) and slope of the roof. Approximate locations are indicated for roof-mounted vents and skylights. Roofing materials that provide protection from the elements are also shown.

Pitch

Roof pitch refers to the angle (slope) of a roof. See Figure 8-22. Houses can have roofs with a common pitch or with various pitches. For example, a straight gable roof without offsets has one common pitch for the entire roof. The same gable roof with dormers can have one pitch on the main roof and a different pitch on the dormers. When multiple roof pitches are used to construct a roof, it is referred to as an unequal pitch roof.

Roof pitch is shown on prints using a slope diagram (small triangle). Two numbers—unit rise and unit run—are included with the slope diagram. The unit rise is the number of inches that a rafter rises vertically for every foot of unit run. The unit run is the horizontal measurement along the slope diagram and is always 12″.

Roofing Materials

Waterproof materials are used to cover the upper surface of the roof sheathing to prevent moisture from entering the house. Products made of asphalt, fiberglass, wood, clay, and metal provide the required weather protection.

Composition Roofing. Asphalt or fiberglass shingles coated with a thin layer of fine mineral granules are approximately ⅛″ thick, 12″ wide, and 36″ long. Asphalt or fiberglass shingles covered with mineral granules are referred to as composition shingles. See Figure 8-23.

Many different colors of mineral granules are available. Dark-colored composition shingles absorb more heat than light-colored composition shingles. The use of dark roof shingles may require additional ventilation for the attic due to additional heat buildup.

Asphalt shingles were first used as a roofing material in the late 1800s. Asphalt shingles have a life expectancy of 15 to 25 years depending on the shingle quality and manufacturer.

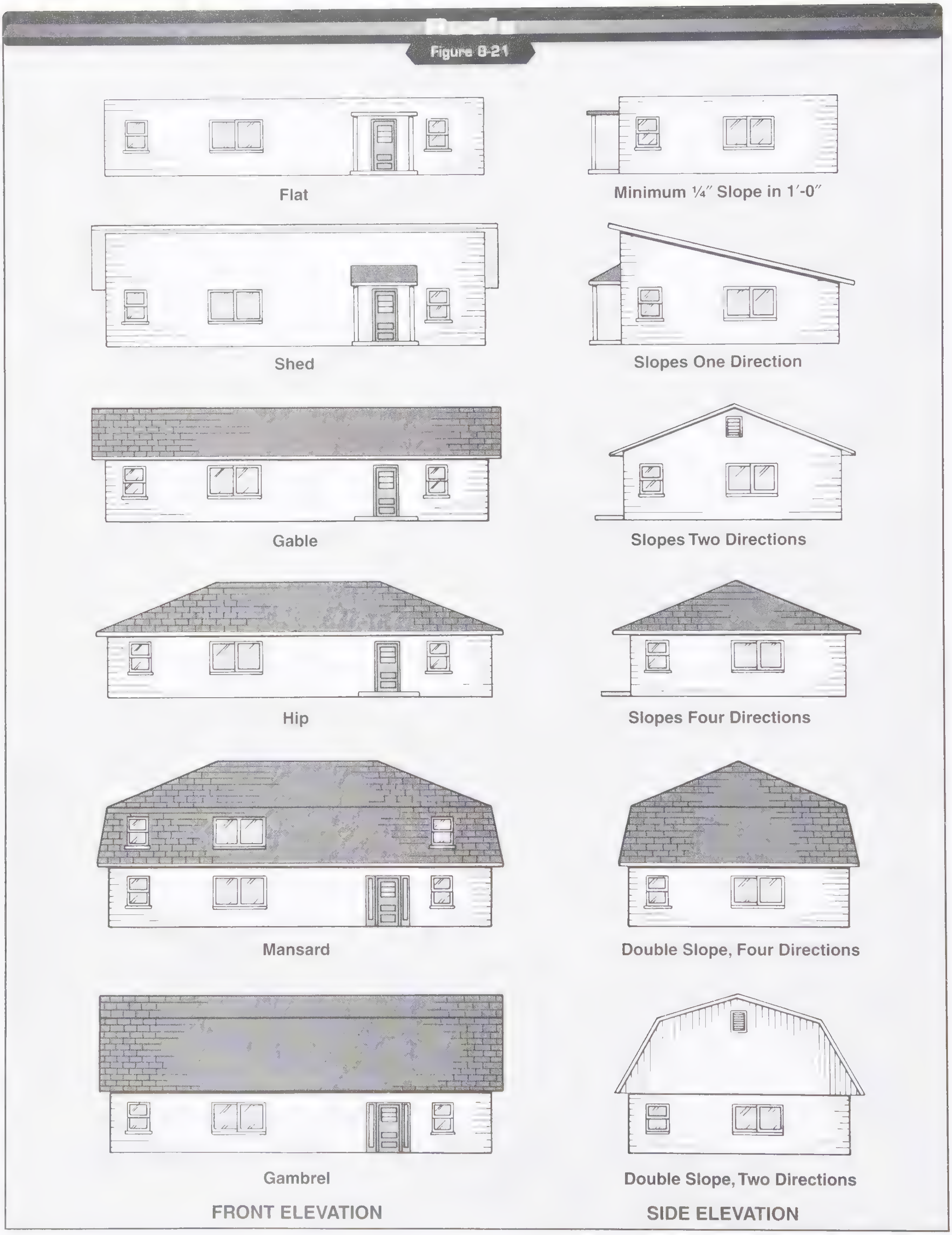


Figure 8-21. Roof shape is indicated on elevations and is shown on several different views of the house.

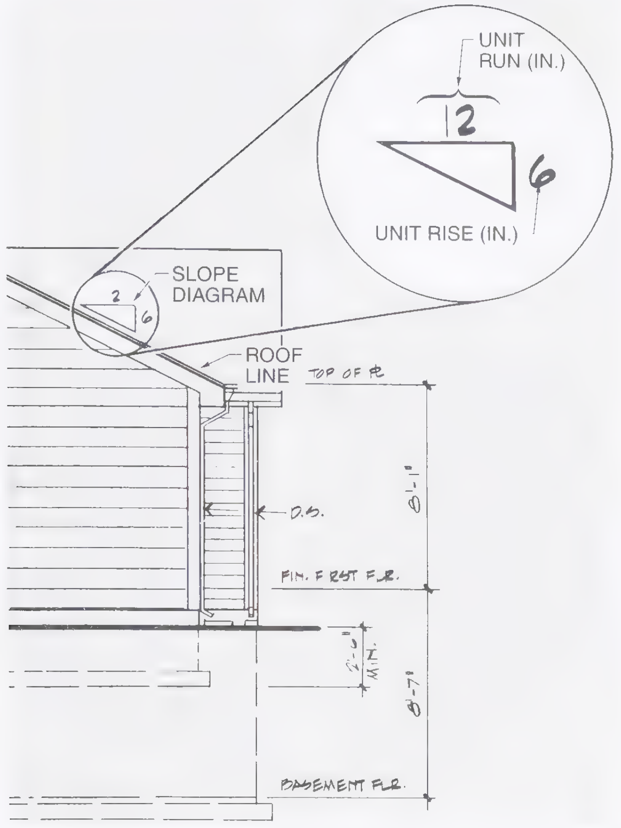


Figure 8-22. Roof pitch is indicated on elevations using a slope diagram.

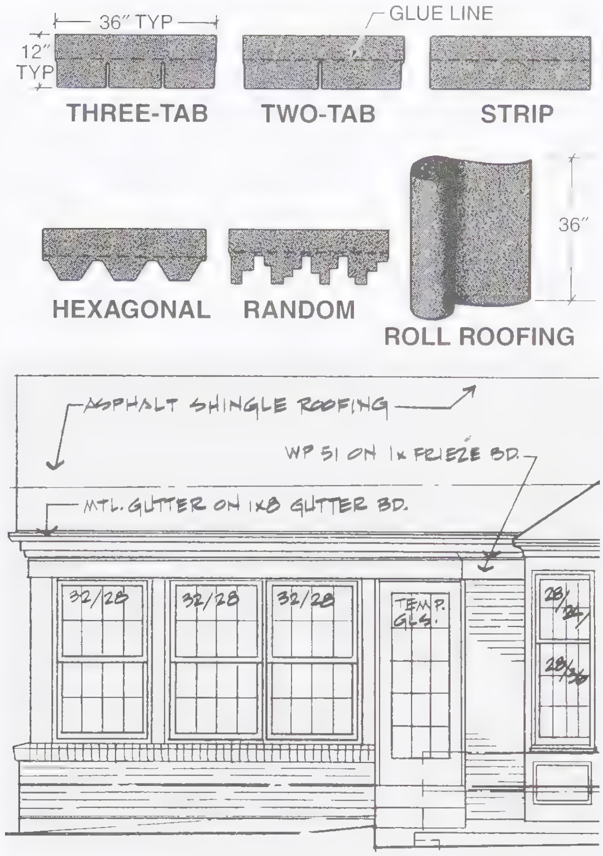


Figure 8-23. Composition roof coverings include shingles and roll roofing.

One or two slots can be cut into the long side of composition shingles to create the appearance of smaller shingles. Shingles with a single slot are two-tab shingles, while shingles with two slots are three-tab shingles. Composition shingles are also available without tabs or with many tabs and irregular widths to create the appearance of many small shingles. Shingles known as seal-down shingles have a small amount of asphalt applied along the back to hold the tabs in place and prevent wind damage.

The quality of composition shingles is expressed by weight in pounds per square foot (psf). Heavy shingles provide better roof protection than lightweight shingles. The weight of composition shingles is measured in pounds per square. A square of shingles is the amount needed to cover 100 sq ft of roof area. Weights range from 135 lb per square to 325 lb per square. Three bundles of composition shingles typically make up one square.

Composition shingles are applied over a layer of asphalt paper using galvanized nails or staples. Installation begins along the bottom edge of the roof and proceeds upward toward the ridge. Each successive course overlaps the lower course. The recommended amount of exposure varies with the slope of the roof and the manufacturer's specifications.

Flashing is required at the junction of a pitched roof and vertical wall. Flashing must also be installed around roof projections, such as vents.

Composition shingles are shown on the exterior elevations with an architectural notation and a series of horizontal lines drawn on the roof. The weight of the shingles may also be noted.

Another composition roof covering material is roll roofing. Roll roofing is manufactured from the same material as composition shingles and is available in 36″ wide by 33′ long rolls. Roll roofing is unrolled horizontally on the roof and fastened in place with galvanized nails or staples. Joints are overlapped and sealed with asphalt.

Built-up Roofing. Seams in composition shingles and roll roofing have a tendency to allow water seepage into the house if applied to a roof with only a slight slope. On flat roofs, built-up roofing forms a tighter seal between

layers of roofing materials and closes these seams. See Figure 8-24. Metal edging called a gravel stop applied around the roof perimeter retains the asphalt and gravel topping and prevents edge leaks.

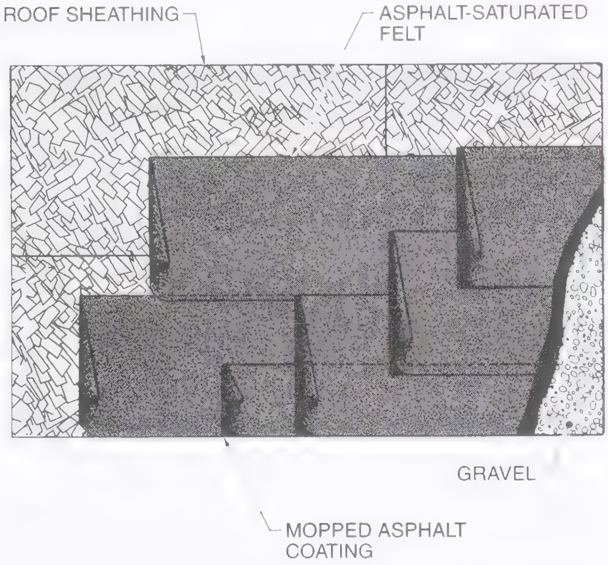


Figure 8-24. Built-up roofing is applied in layers and is commonly used on flat roofs.

Several layers of asphalt-saturated felt are applied to the surface of the roof. Each successive layer is sealed down with hot asphalt before the next layer is applied. All seams are waterproofed. After the final layer of felt and asphalt are applied, a layer of gravel is spread over the surface as a protective topping. Built-up roofing is not seen on exterior elevations of flat roofs because the roof surface is parallel to the line of sight of the orthographic projection. Rather, architectural notations are used to indicate built-up roofing.

Wood Shingles and Shakes. Cedar is cut into 16″ to 32″ lengths, then sawn into shingles or split into shakes. Roof sheathing may be fastened to the rafters or trusses, or wood battens may be fastened at 90° to the rafters or trusses for use as a base for the shingles. Asphalt-saturated felt is fastened to the roof sheathing or battens before wood shingles or shakes are attached. The shingles or shakes are applied from the bottom of the roof and worked toward the ridge, with successive courses overlapping horizontal and vertical joints. Exposure varies with the width and thickness of the shingles or shakes and the roof pitch. Wood shingles and shakes are noted on exterior elevations and shown with closely spaced lines. See Figure 8-25.

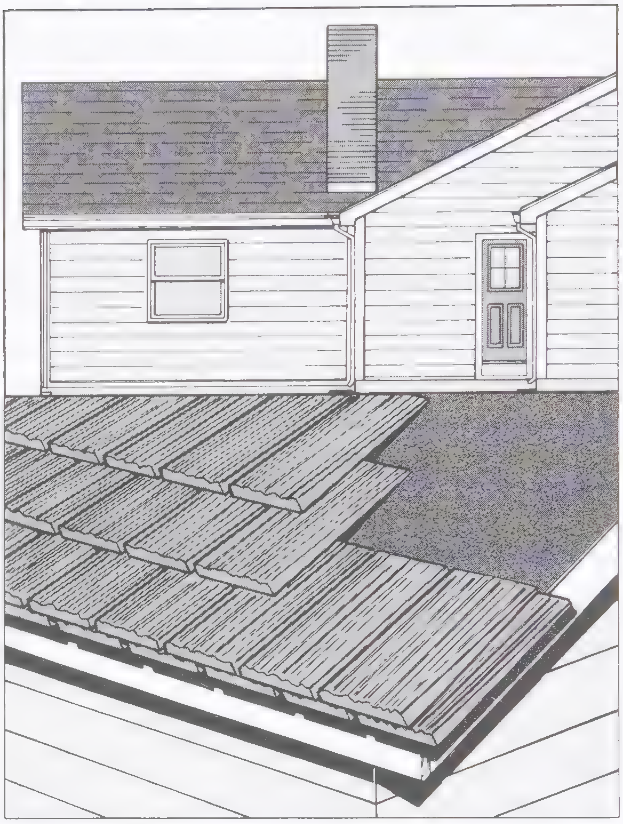


Figure 8-25. Wood shingles are shown on elevations with closely spaced lines.

Wood shingles and shakes are typically cut with a utility knife and are applied from the bottom of the roof working toward the ridge.

Tile. Clay, terra-cotta, or lightweight concrete roofing tile is available in a variety of shapes. See Figure 8-26. Clay tile is much heavier than other roofing materials and requires stronger roof framing. Tiles are attached to roof sheathing or battens nailed at 90° across the tops of the rafters. Tiles are nailed to the roof, with each successive tile covering the nailing edge of the previous tile and the top of the tile in the lower course.

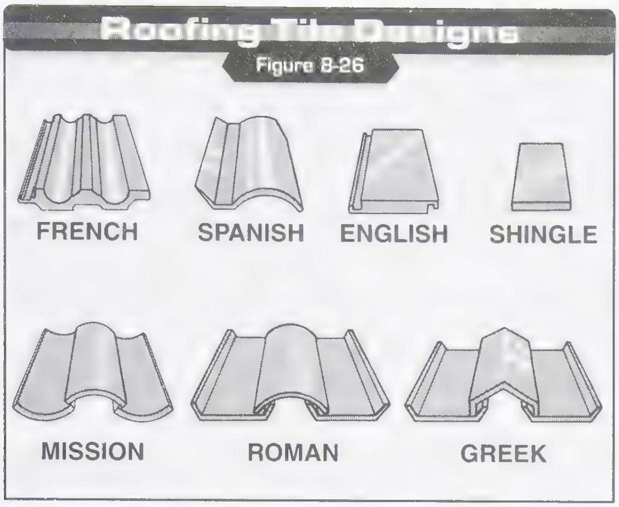


Figure 8-26. Roofing tile is available in a variety of designs.

Clay tile is lighter than concrete tile. However, concrete tile is more durable and is used more often in residential construction than clay tile.

Clay, terra-cotta, or lightweight concrete tile is noted on exterior elevations with architectural notations and a series of regular-shaped rectangles. The roof edge may be shown with a wavy line, showing the exposed edges of the lowest course of tile.

Metal. Copper, galvanized steel, aluminum, and other metals provide a contemporary roof finish that is weather-resistant and decorative. See Figure 8-27. Metal roof materials include metal panels and metal shingles.

When installing metal panels, each metal sheet is joined to the adjacent piece to form a watertight joint. Several types of metal roofing joints are used to join metal panels to create a weatherproof seal. The joint used depends on the roof pitch and the type of metal. Joints in metal sheets are preformed for hard metals such as steel. Where soft metals such as copper are to be installed, joints can be formed at the job site. The width, length, and gauge (thickness) of metal sheets vary depending on the type of metal. The type of metal roofing is noted on exterior elevations.

Metal shingles are made of aluminum or galvanized steel and are available in solid colors as well as designs that provide the appearance of wood shingles and shakes. Metal shingles are applied individually or in panels. Individual shingles are applied over wood battens. Panels may have battens attached to their backs.

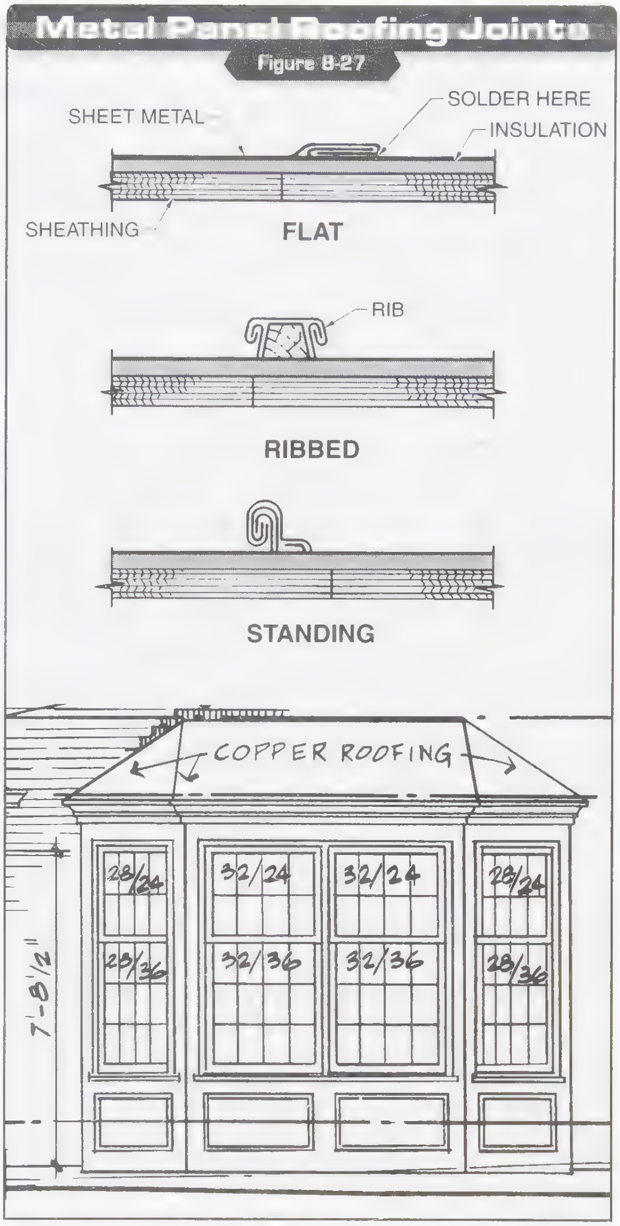


Figure 8-27. Metal panel roofing provides a contemporary roof finish for residential construction.

Dormers

Dormers are roof projections that form a break in the roofline. See Figure 8-28. Gable and shed dormers are the most common, but hip or gambrel dormers can also be constructed. A dormer projects out from the main roof at 90° and typically has one or more windows. The design and roof pitch are indicated on exterior elevations. The slope diagram for a dormer roof is placed directly over the sloped portion of the dormer roof.

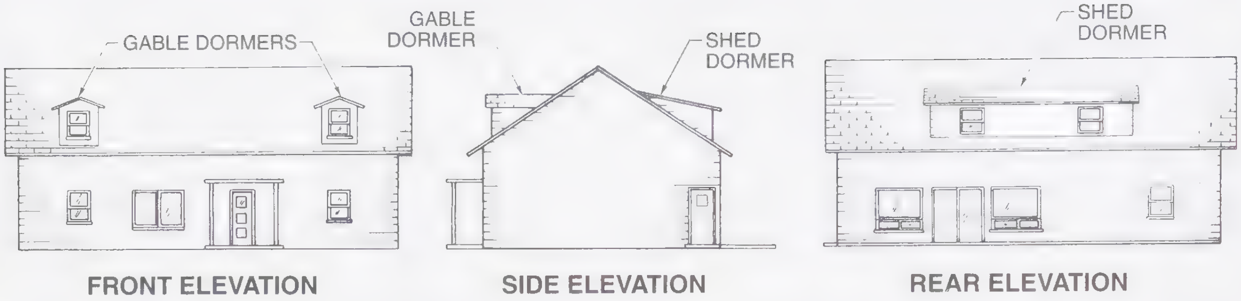


Figure 8-28. Dormers projecting from the main roof provide additional living space.

Crickets

Crickets, also known as saddles, are elevated roof areas behind chimneys or other vertical projections through a sloping roof. Crickets are triangular in shape to help divert rainwater and snow and to prevent accumulation of rain and snow behind the vertical projection. Crickets are typically constructed at the same pitch as the main roof and are covered with asphalt-saturated felt and flashing in the two valleys that are created. See Figure 8-29. An architectural notation on exterior elevations indicates crickets.

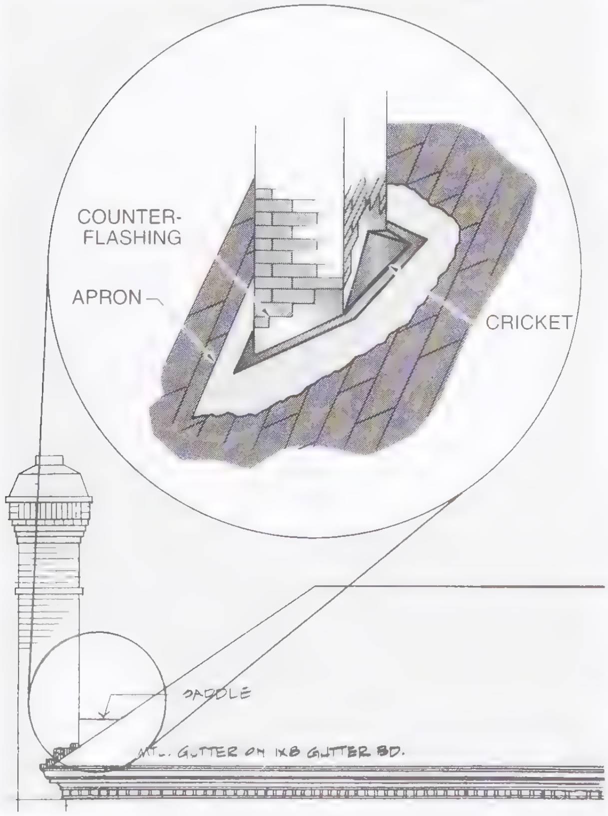


Figure 8-29. Crickets divert rainwater and snow and prevent accumulation of rain and snow behind vertical projections.

Crickets are formed from various soft metals such as galvanized sheet metal or copper.

Gutters

Gutters, or eaves troughs, are formed from galvanized sheet metal, aluminum, copper, or plastic. Gutters may be unfinished to show the natural finish of the metal, or they may be finished with a colored, baked enamel finish to match the siding. Gutter sections are available in 10′, 20′, and 33′ lengths, or gutters may be formed to custom lengths on the job site from a metal roll. The face surface of a gutter typically has an ornamental design to strengthen it and improve its appearance. See Figure 8-30.

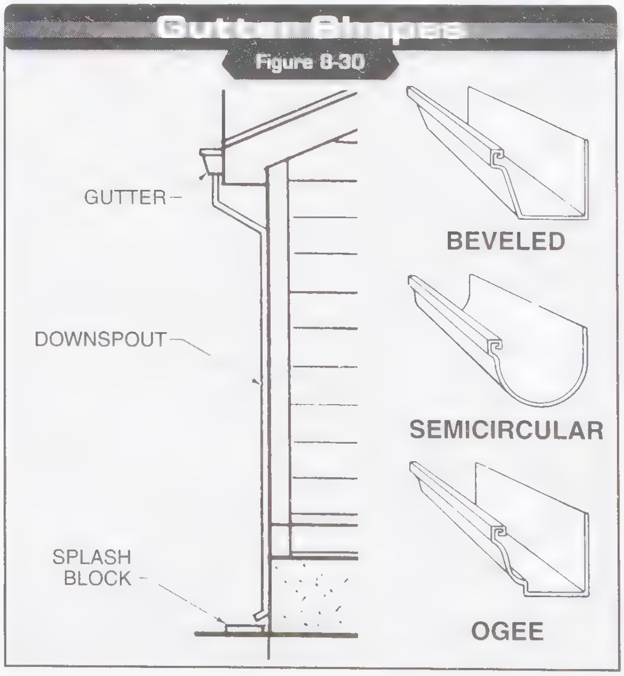


Figure 8-30. Gutters, downspouts, and splash blocks channel rainwater away from a house.

Gutters are attached horizontally to the exterior trim member known as the fascia board. The fascia board covers the lower ends of the rafters or trusses. Gutters are fastened to the fascia board at a slight slope using screws or nails to provide proper water drainage. The recommended minimum slope for gutters is approximately ¼″ for each 10′, depending on the length of gutter between downspouts and the width of the fascia board. Corner brackets and end caps are utilized to retain water throughout the gutter system. Gutters are shown on exterior elevations with object lines.

Openings are precut in the bottom of some gutter sections at the ends to allow water to escape. Downspouts are attached to the openings to carry water to the ground for dispersion. Various types of elbows and other fittings are installed in downspouts to allow for the transition around overhangs and at the bottom to divert water away from the structure. Straps secure the downspouts to the exterior wall. Metal, plastic, or concrete splash blocks are set on the ground below downspouts to prevent the water from washing the soil away. Downspouts and splash blocks may be shown on exterior elevations with centerlines and architectural notations.

Flashing

Flashing covers areas at the joints between various exterior finish materials. See Figure 8-31. Flashing is made of galvanized sheet metal or aluminum and is cut into the desired lengths as needed. Flashing is flat, L-, Z-, or S-shaped, or angular. Depending on the methods of application and the materials used, flashing is installed at different times in the construction process. Flashing is shown on exterior elevations with object lines, hidden lines, and architectural notations.

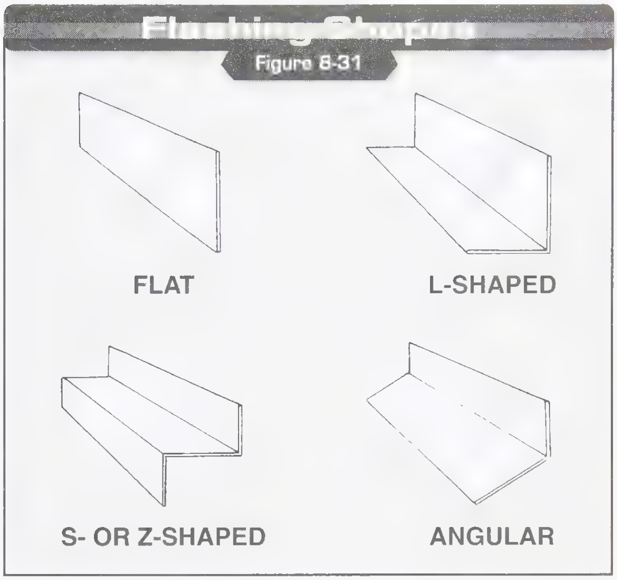
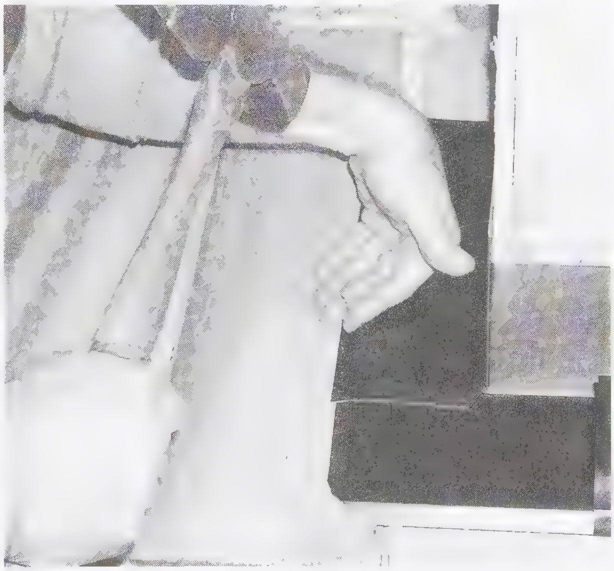


Figure 8-31. Flashing covers joints between exterior finish materials.



Flashing is installed at the junction of two surfaces that are oriented differently to prevent rainwater from penetrating into the structure.

EXTERIOR ORNAMENTATION

Some materials attached to the exterior of a house provide little or no weather protection or structural support. Ornamental items are included in a design to enhance the exterior appearance. Wood, metal, or plastic ornamentation, such as railings, columns, shutters, and cupolas, create a more pleasing and complete appearance for the exterior of a house.

Masonry sill and coping flashing should have a drip edge to divert water away from the building.

Railings and Columns

Ornamental items on porches include wood, metal, or plastic railings and columns. See Figure 8-32. Railing components are the top rail, bottom rail, and balusters or safety rails between the top and bottom rail. Balusters can be square or shaped into decorative designs.

Wood, metal, or plastic exterior columns may be hollow or solid and are typically square or round. In some cases, wood and metal exterior columns may provide

structural support for house and porch roofs. Columns may be grooved with vertical flutes and have trim members attached to create a decorative appearance.

Railings and columns can be made of wrought iron. Wrought iron is a material manufactured from the basic iron (pig iron) from a blast furnace. Almost all the carbon and trace impurities are removed in the manufacture of wrought iron. This low-carbon iron is easily shaped and joined. Wrought iron is available in a variety of shapes. Wrought iron columns may be used to support lighter loads. Exterior railings and columns are shown on exterior elevations and indicated with architectural notations.

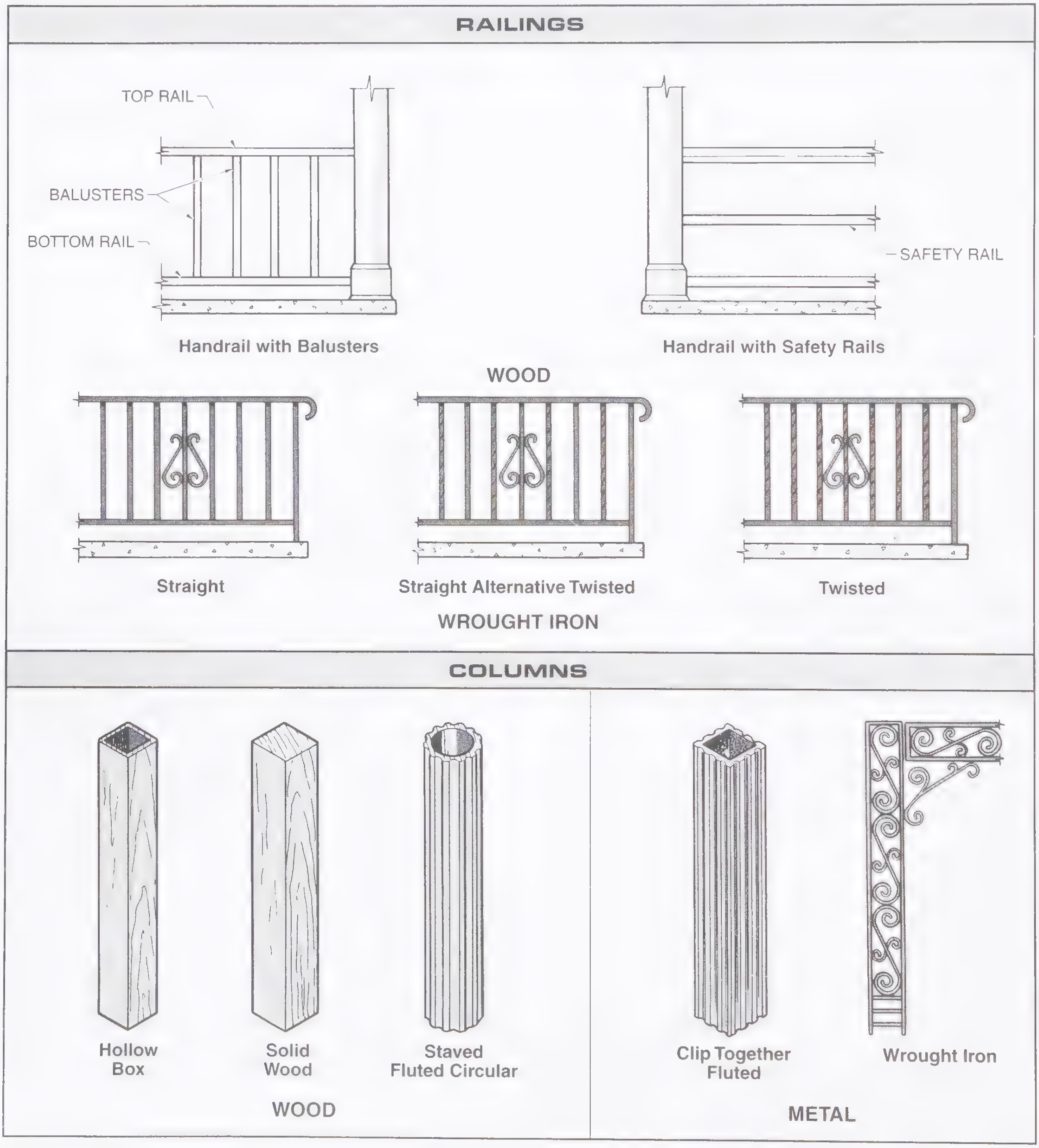


Figure 8-32. Railings and columns are ornamental items but may provide some structural support.

Shutters

Shutters are installed on both sides of windows when indicated on elevations. A variety of designs and various materials are used to manufacture shutters. See Figure 8-33. Common designs include louvered with horizontal slats, vertical boards with horizontal trim (slatted), or flat with panels applied to the face. Shutters are manufactured in standard sizes to correspond to common window widths and heights. Shutter sizes vary in width from 14″ to 16″ and in height from 25″ to 81″.

Shutters are attached to the exterior wall after the exterior finish has been applied. On masonry-veneer walls, shutters are attached to the masonry using anchors. Shutter locations and designs are shown on exterior elevations.

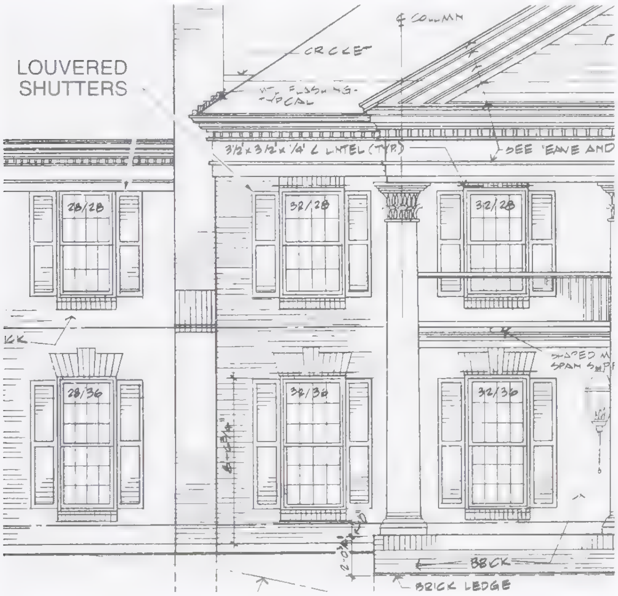


Figure 8-33. Shutters provide a decorative finish along the sides of windows.

Cupolas

A cupola is a small rooftop ornament installed on the roof ridge. See Figure 8-34. A cupola projects above the ridge several feet and is commonly topped with a weather vane or some other ornamental item. Cupolas can also cover rooftop vents or have louvered faces to provide ventilation. Locations and designs for cupolas are shown on exterior elevations.

ELEVATIONS AND HEIGHTS

Elevation dimensions on exterior elevations show the grade of the lot around the building and the depth or height of the foundation. Heights of the first floor and additional floors in multistory houses are also shown on exterior elevations. See Figure 8-35.

In addition to elevation dimensions, extension and dimension lines on exterior elevations provide information regarding the overall height of objects in feet, inches, and fractions of an inch.

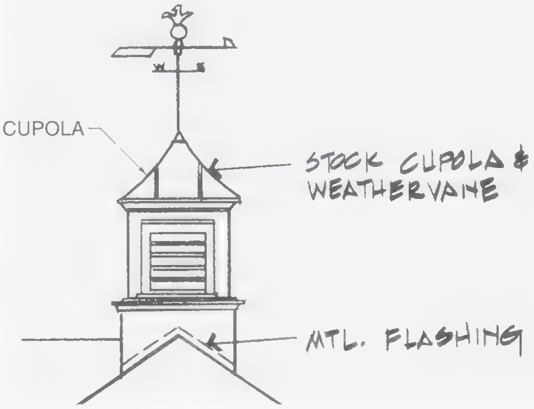


Figure 8-34. Cupolas are installed on the ridge of a roof and can be either strictly decorative or used to provide attic ventilation.

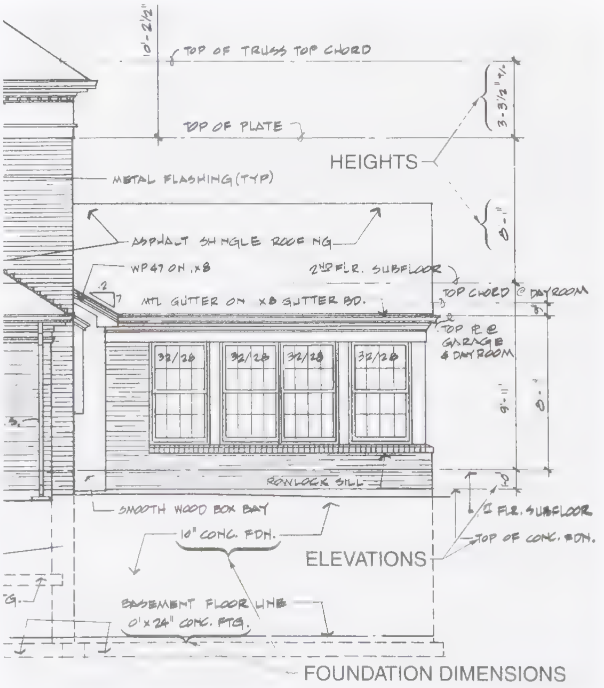


Figure 8-35. Exterior elevations show heights and elevation dimensions for grading, foundation, floor, and roof levels.

Grading

Horizontal extension lines show the elevation dimensions of the grade of the lot directly around the house. These elevation dimensions are the same as those shown on the plot plan. Elevation dimensions are expressed in feet and hundredths of a foot.

Foundation

A foundation that projects above the grade line is shown with object lines. A below-grade foundation is shown on exterior elevations as hidden lines. The footing and foundation wall depths, piers, grade beams, and other foundation dimensions are shown on elevations with extension and dimension lines. Foundation dimensions are expressed in feet, inches, and fractions of an inch.

Floor

Horizontal extension lines project from the house object lines. Elevation dimensions of various items, such as floor levels or window and porch heights, are placed along the extension lines. Elevation dimensions for these items are expressed in feet, and tenths and hundredths of a foot.

Vertical dimension lines can also be used to indicate the height of floor levels or window and porch heights. The dimensions are expressed in feet, inches, and fractions of an inch. For example, in Figure 8-35 the height of the second-floor subfloor is 9′-11″ above the first-floor subfloor.

Ceiling/Roof

Heights for the top wall plates, ceiling lines, and tops of the roof ridge boards are shown on exterior elevations. Top plate heights are the same as ceiling heights for flat ceilings. Ridge board heights or the elevation of the tops of the trusses can also be noted. For example, in Figure 8-35 the top plate in the garage and day room is 8′-1″ above the first-floor subfloor, and the top plate for the second floor is 8′-1″ above the second-floor subfloor. The top of the truss top chord is approximately 3′-3 ½″ above the second-floor top plate.

INTERIOR ELEVATIONS

Where special interior finishes are to be applied, the architect provides an interior elevation. An interior elevation shows one wall or section of a wall using orthographic projection. Interior elevations are provided for kitchens, bathrooms, and other special finishes such as shelves and fireplaces. See Figure 8-36.

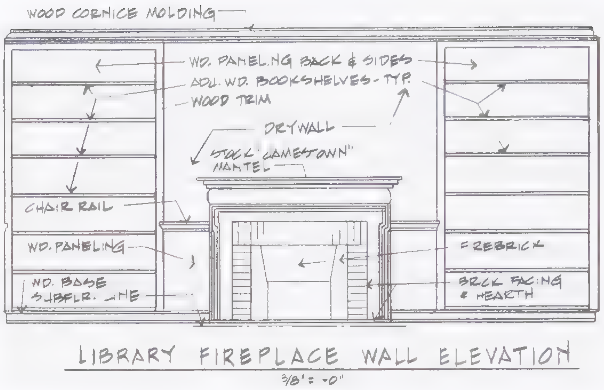


Figure 8-36. Interior elevations show special finishes such as shelves and fireplaces.

Kitchen

The design of kitchen cabinets and locations of appliances are shown on interior elevations of the kitchen. Direction of swing for cabinet doors is shown with dashed lines that converge at the hinged side. The exterior finish of the cabinets can also be noted. Hidden lines show shelf locations inside the cabinets. Section lines detail the profile of cabinets projecting toward the viewer.

Walls in the kitchen are commonly covered with durable, waterproof materials such as ceramic tile. The type of materials applied and the dimensions of the areas to be covered are shown on interior elevations. Occasionally, kitchen elevations are drawn at a larger scale than exterior elevations. The larger scale allows the architect to show more details for the tradesworker.

Bathroom

Plumbing fixture locations are shown on interior elevations. The types of fixtures installed may also be noted. Locations and sizes of medicine cabinets and mirrors are also indicated.

Ceramic tile, cultured marble, granite, or other waterproof materials are commonly applied as finish wallcovering in bathrooms. The location and dimensions of the area to be covered are shown.

Special Conditions

Built-in bookshelves, display cases, and other custom cabinets are shown with interior elevations that provide dimensions, locations, and information regarding types of construction materials. Special wallcovering conditions, such as a wainscot, are shown on interior elevations. Wainscot is a special finish applied to the bottom

section of a wall, commonly to a height of 32″. A chair rail is a horizontal trim member that covers the joint between the upper and lower wall finishes.

Fireplace opening dimensions, hearths, and mantles are also shown on interior elevations. The hearth is the horizontal area in front of a fireplace covered with a fireproof material such as ceramic tile or stone. The hearth may be raised above the floor line or built flush with the floor level. A mantle is a shelf above the fireplace opening and the trim members installed around the firebox opening. The materials and design of the mantle are shown on interior elevations.

MATERIAL ESTIMATING

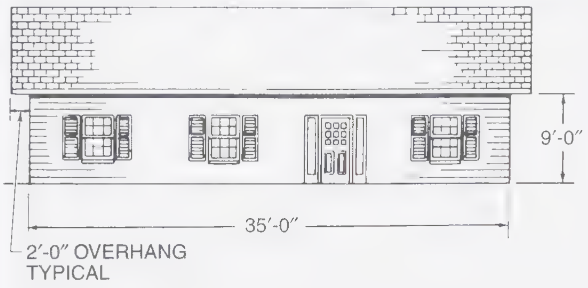
Elevations show the materials applied to the exterior of the house and special interior finishes. The amount of each type of material, such as siding, masonry, or roofing, is estimated differently. See Figure 8-37. Additions of various percentages are made to the material estimates to allow for the construction waste that occurs during normal installation on the job site.

Calculations are made to determine the approximate amounts of materials needed, and there often are fractional remainders in the calculations. The remainders are always rounded up to the next highest whole number. For example, if a calculation determines that 57.4 lf (linear feet) of brick mold is needed, 58 lf are ordered.

When estimating exterior finish materials, deductions may be made for door and window openings. The deductions will reduce the total amount of materials required, reducing the amount of materials needed. Note that in the following examples no deductions for openings have been made (unless otherwise noted).

Estimating Exterior Materials

Figure 8-37



SIDING (FRONT WALL ONLY)

1. 35′ × 9′ = 315 sq ft
2. 315′ × .05 (waste) = 15.75 + 315 = 330.75 sq ft
3. 330.75 ÷ 100 = 3.3075 = 3.3 = **4 squares**

BRICK (FRONT WALL ONLY)

1. 35′ × 9′ = 315 sq ft
2. 315 × 7 bricks per sq ft = 2205 bricks
3. 2205 × .03 (waste) = 66.15 = 67 bricks
4. 2205 + 67 = 2272 bricks
5. 2272 ÷ 250 per pallet = 9.1 = **10 pallets**

ROOFING (ENTIRE ROOF)

1. 39′ × 12′ (rafter length) = 468 sq ft
2. 468 × 2 (both sides) = 936 sq ft
3. 936 × .05 (waste) = 46.8 = 47 sq ft
4. 936 + 47 = 983 sq ft
5. 983 ÷ 100 = 9.83 = **10 squares**
6. 39′ of ridge ÷ 33′ per bundle = 1.2 = **2 bundles**

Figure 8-37. Each type of exterior finish material is estimated differently.

Siding

The types of siding materials applied to a house are shown on the elevations with symbols and architectural notations. When estimating siding, the exterior wall surface area must first be determined. The area is then divided by 100 to determine the number of squares of wood siding required. Each 100 sq ft area equals one square. For example, an exterior wall measuring 35′ long by 9′ high contains 315 sq ft (35′ × 9′ = 315 sq ft). In this example, 5% (15.75 square feet) is added for waste (315 sq ft + 15.75 sq ft = 330.75 sq ft). Approximately 3⅓ (3.3) squares of siding are needed to cover the wall (330.75 ÷ 100 = 3.3075). Four squares of siding are to be ordered.

Wood siding is packaged and delivered to the job site in bundles containing one square each. Metal siding is bundled in one square packages with expanded foam backing board or in two square packages without the board. Vinyl siding bundles contain two squares of siding.

In addition to the siding, the required amounts of trim members and soffit materials are determined from the exterior elevations. Trim members are calculated in linear feet. Soffit materials required are commonly calculated in square feet of coverage. The number of square feet of soffit covering required is based on a calculation of the overall soffit length and width.

Brick

Brick and masonry estimates are based on the number of masonry units needed to cover 1 sq ft. The number of brick needed to cover 1 sq ft of exterior wall depends on the type of brick bond used and the thickness of the mortar joints.

A face brick used for residential brick-veneer construction has a 4″ × 2⅔″ × 8″ nominal size. The actual size of the brick is smaller and is selected based upon the thickness (either ⅜″ or ½″) of the mortar joint used. Brick is packaged and delivered on pallets with each pallet containing 250 bricks.

Additional bricks are included in the estimated total to allow for headers, sills, and waste. The waste allowance for brick varies from 3% to 6%.

As an example, a wall measuring 35′ long by 9′ high (315 sq ft) is to be covered with brick veneer. A standard modular brick covers approximately ⅐ sq ft. The number of bricks per square foot is multiplied by the wall area (7 × 315 = 2205 bricks). A 3% waste, or 67 additional bricks, are added to the subtotal (2205 + 67 = 2272 bricks). With 250 bricks per pallet, the total number of bricks is then divided by 250 to determine the number of pallets (2272 ÷ 250 = 9.1 pallets). Ten pallets of brick are to be ordered.

The number of bricks per square foot is multiplied by the wall area to determine the number of bricks required for a wall (without waste).

Roofing

Roof areas to be covered are calculated based on the number of squares (100 sq ft). The roof width is multiplied by the rafter length to determine the total roof area (in square feet). A waste allowance, typically 5%, is added to the total roof area. The total roof area and waste allowance total is divided by 100. In addition, the length of any ridge and hip areas to be covered is added.

Composition roof shingles are packaged in bundles, each containing 33 sq ft. Three bundles or rolls of roofing material cover one square. Each bundle of composition roof shingles will cover 33 lf of ridge.

As an example, roofing material must be estimated for a gable roof measuring 39′ wide with 12′ long rafters. The roof area of one side of the roof is 468 sq ft (39′ × 12′ = 468 sq ft). The roof area for one side is doubled to account for both sides of the roof (468 sq ft × 2 = 936 sq ft). The total roof area is multiplied by the waste percentage to determine the amount of waste (936 sq ft × .05 = 47). The total roof area is then added to the amount of waste (936 + 47 = 983 sq ft). The total is then divided by 100 to determine the number of squares required (983 ÷ 100 = 9.83 squares). For composition shingles, an additional 2 bundles of shingles are added to cover the 39′ of ridge. It will be necessary to order 10 squares plus 2 bundles of composition shingles for the roof. For other roofing materials, a similar amount of ridge covering material is added.

ABBREVIATIONS AND SYMBOLS

Exterior finish materials are shown on exterior elevations with abbreviations and symbols. The symbols on elevations are also common to details. Standard abbreviations and symbols are specified by the American National Standards Institute (ANSI). The meaning of any abbreviation or symbol that deviates from the standards should be verified.

Abbreviations

Materials covering the exterior and interior walls are noted with abbreviations on elevations. See Figure 8-38. Types of doors, windows, and vents are indicated with abbreviations. Electrical luminaires and devices and plumbing fixture types are noted with abbreviations.

Symbols

Exterior wallcoverings are noted on elevations using standard symbols. See Figure 8-39. The symbols represent siding, masonry, metal, plaster, shingles, doors, windows, and other finish materials.

OTHER REFERENCES

Additional information about exterior and interior wall finishes is included on other parts of prints. Floor plans, details, and specifications are cross-referenced with the elevations to give the required construction information.

ELEVATION ABBREVIATIONS

Abbreviation	Term	Abbreviation	Term
AC	Air conditioner	MET J	Metal jalousie
ALUM	Aluminum	MGS	Metal gravel stop
ANT	Antenna	OB	Obscure
AWN	Awning	OBSC GL or OGL	Obscure glass
BC	Bookcase	OPG or OPNG	Opening
BD	Board	OVHG	Overhang
BEV	Beveled	P	Pitch
BK SH	Book shelves	PK	Peak
BRK	Brick	PL GL	Plate glass
BRS	Brass	PLAS	Plaster
BRZ	Bronze	PLR	Pillar
BUR	Built-up roofing	PLSTC	Plastic
CAN.	Canopy	PNT	Paint
CI	Cast iron	PTD	Painted
CL GL	Clear glass	QTR	Quarry tile roof
CLG	Ceiling	RD	Roof drain
CLKG	Caulking	RDG	Ridge
CMPSN	Composition	RF	Roof
CMU	Concrete masonry unit	RFG	Roofing
COR	Cornice	RR	Roll roofing
CORR	Corrugated	RS	Rubble stone
CPLR	Center of pillar	RSTPF	Rustproof
CRE	Corrosion-resistant	SB	Splash block
CST or CS	Cast stone	SCR or SCRN	Screen
CSMT	Casement	SDG	Siding
CTD	Coated	SDL	Saddle
CUTS.	Cut stone	SDLT	Sidelight
DH	Double-hung	SF	Soffit
DHW	Double-hung window	SH or SHT	Sheet
DR	Door	SHGL	Shingle
DRM	Dormer	SHK	Shake
DS	Downspout	SHTHG	Sheathing
DSG	Double-strength glass	SHTR	Shutter
ENAM	Enamel	SL	Slate
EXHV	Exhaust vent	SLT	Skylight
EXPSR	Exposure	SM	Sheet metal
EXT	Exterior	SS	Steel sash
EXT GR	Exterior grade	SSG	Single-strength glass
FB	Face brick	STK	Stack
FL	Flashing	STN	Stained
FL	Floor line	STN	Stone
FLD	Field	TC	Terra-cotta
FNSH FL	Finished floor	TH	Threshold
FR	Front	THRM	Thermal
FX WDW	Fixed window	TMPD	Tempered
GALV	Galvanized	TSR	Tile-shingled roof
GALVI	Galvanized iron	VAL	Valley
GALVS	Galvanized steel	VCT	Vitrified clay tile
GL	Glass	VP	Vent pipe
GLB	Glass block	VS	Vent stack
GLZ	Glaze	WD	Wood door
HMD	Hollow metal door	WH	Weep hole
KPL	Kickplate	WI	Wrought iron
LMS or LS	Limestone	WIND	Window
LNTL	Lintel	WJ	Wood jalousie
LT	Light	WS	Weatherstripping
LTH	Lath	WSCT or WAIN	Wainscot
LV or LVR	Louver	WSR	Wood-shingle roof
MET F	Metal flashing	WT	Wood threshold
		WTHPRF	Weatherproof

Figure 8-38. *Abbreviations on elevations indicate finish materials, door and window types, and exterior and interior fixtures.*

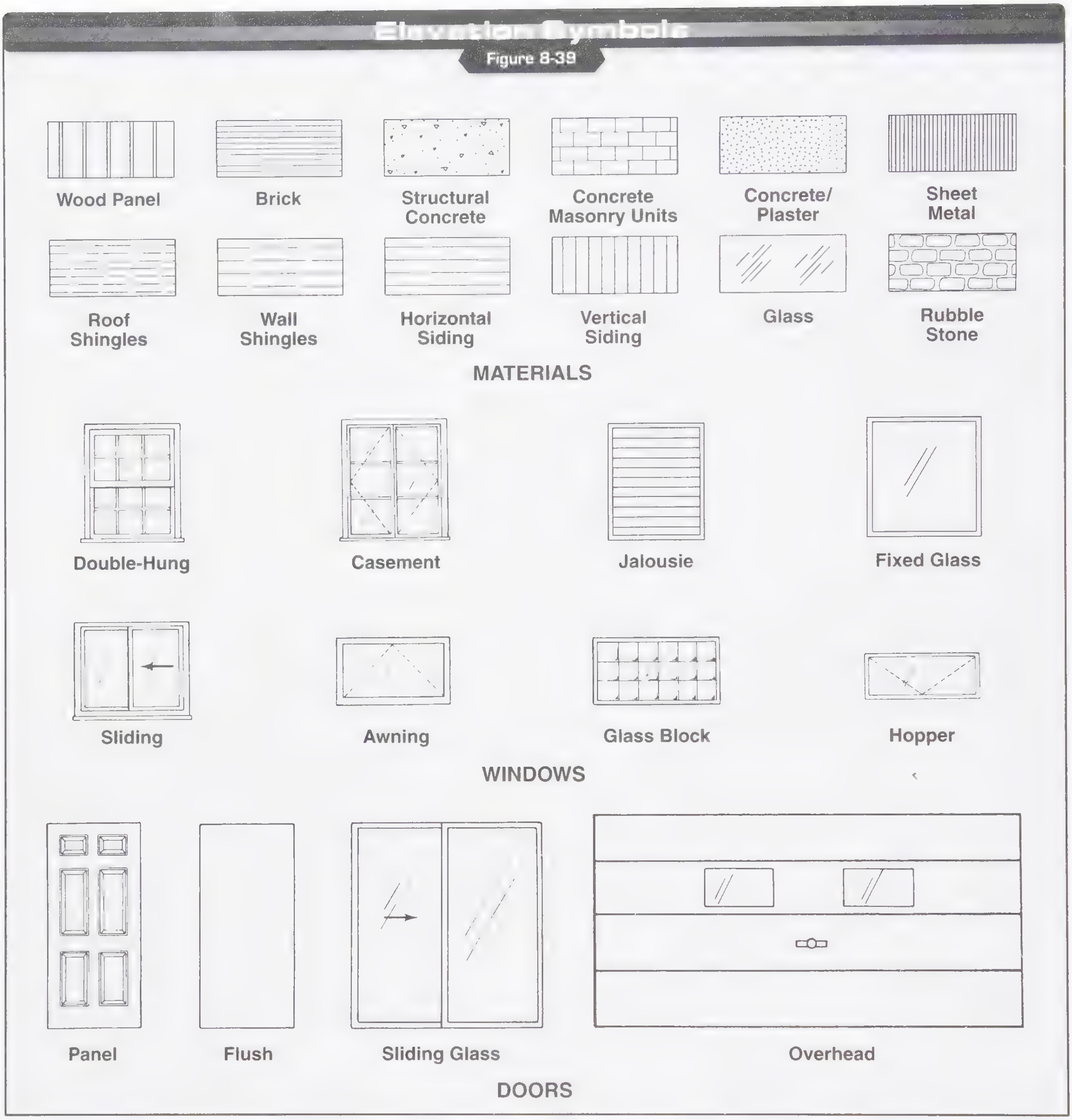


Figure 8-39. Exterior finish materials, windows, and doors are shown on elevations with symbols.

Floor Plans

Dimensions on floor plans indicate wall lengths required for material estimating. Locations of windows, doors, and vents, and directions of door swing are shown on floor plans. See Figure 8-40. Framing information for bay and bow window construction is also noted on floor plans. Roof framing information assists in calculations for determining roofing materials and dormer trim. Schedules on floor plans provide specific information about doors and windows. Floor plans also provide some information about interior finish materials.

Floor plans provide the majority of information required to construct a house.

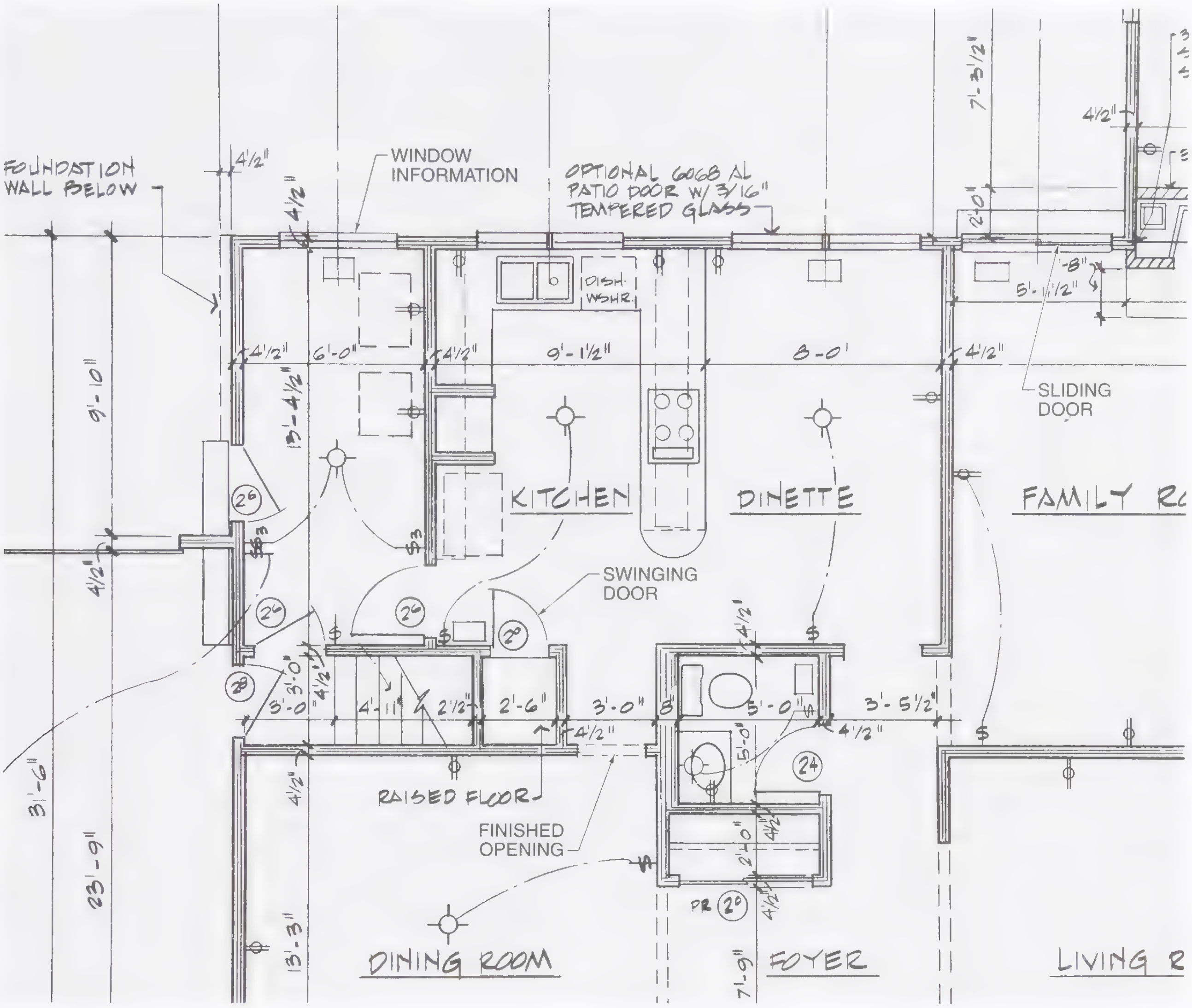


Figure 8-40. *Floor plans provide information about interior and exterior wall openings.*

Details

Exterior details provide specific information about the types and sizes of exterior construction materials and their applications. Interior details show imaginary slices through walls and other finish items that appear on interior elevations.

Specifications

Written descriptions of finish materials and the methods of application are typically included in the specifications. Siding, exterior finish, masonry, and roofing material requirements are also indicated in the specifications. Door and window types may be noted in the specifications with the manufacturer's name and code number. See Figure 8-41. Exterior wall and trim colors may also be shown in the specifications.

Alcoa Building Products, Inc

Exterior details provide additional information about building components such as handrails and decorative trim members.

DOOR SCHEDULE			
○	SIZE	TYPE	REMARKS
1	2'-8" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	
2	"	"	
3	3'-0" x 6'-8" x 1 3/4"	SOLID CORE	
4	2'-8" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	
5	2'-6" x 6'-8"	BI-FOLD	2'-6" OPENING
6	2'-6" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	
7	2'-8" x 6'-8" x 1 3/4"	FL. SOLID CORE	
8	3'-0" x 6'-8"	BI-FOLD	3'-0" OPENING
9	3'-6" x 6'-8"	BI-FOLD	3'-6" "
10	5'-0" x 6'-8"	ALUM. SLID'G	5'-0" "
11	2'-4" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	
12	2'-8" x 6'-8" x 1 3/8"	"	
13	4'-0" x 6'-8"	ALUM. SLID'G.	12'-0" UNIT
14	2'-8" x 6'-8"	ALUM. STORM	
15	2'-8" x 6'-8" x 1 3/4"	FL. SOLID CORE	
16	2'-6 x 6'-8"	BI-FOLD	2'-6" OPENING
17	2'-6" x 6'-8"	ALUM. SLD'G.	5'-0" "
18	2'-6" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	
19/20	2'-6" x 6'-8"	BI-FOLD	2'-6" OPENING
21	2'-4" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	2'-4" "
22/23	2'-6" x 6'-8" x 1 3/8"	FL. HOLLOW CORE	
24	4'-0" x 6'-8"	2-BI-FOLD	4'-0" OPENING
25	"	"	"
26	2'-6" x 6'-8"	BI-FOLD	2'-6" OPENING
27	2'-8" x 3'-0" x 1 3/8"	FL. HOLLOW CORE	CRAWL SPACE
28	16'-0" x 7'-0"	O'VHD. 4-PANEL	CEDAR FACED

Figure 8-41. *Specifications, including schedules, provide information regarding the material, equipment, and fixtures to be installed in the house.*

REVIEW QUESTIONS

8

Elevations

Name ______________________ Date ____________

True-False

T F 1. Elevations are isometric drawings.

T F 2. Architects allow open areas on elevations to provide room for notations.

T F 3. Tempered hardboard warps more readily than solid lumber.

T F 4. Wood panel siding does not require flashing.

T F 5. Wood shingles are available in individual pieces or 8′ long panels.

T F 6. A mason's ruler is helpful in calculating the vertical spacing of the brick courses.

T F 7. Metal and vinyl soffit pieces can be solid or ventilated.

T F 8. Stucco plaster is made of sand, water, cement, and lime.

T F 9. The base and finish coats of EIFS contain acrylic resin.

T F 10. Rollers for sliding glass doors are recessed into the track.

T F 11. Horizontal window locations are indicated on elevations.

T F 12. Window sizes are expressed by listing the width first, followed by the height.

T F 13. A fixed window does not open.

T F 14. Location dimensions for plumbing vents are shown on exterior elevations.

T F 15. Clay terra-cotta tile is a lightweight roof covering material.

T F 16. Balusters are horizontal safety rails.

T F 17. Built-up roofing is applied on flat roofs.

T F 18. Shutters are made of wood or plastic.

T F 19. Elevations provide height and elevation dimensions.

T F 20. Wainscot refers to an area where different finishes are used at the top and bottom of the wall.

T F 21. Exterior finish information appears only on exterior elevations.

Multiple Choice

_______________ 1. Cornice trim is installed ___.
- A. at inside corners
- B. at the meeting of roof and walls
- C. only on brick walls
- D. on a wainscot

_______________ 2. Masonry veneer is separated from wood framing members by ___″ to create an air space.
- A. 1
- B. 2
- C. 3
- D. 4

_______________ 3. Metal and vinyl lap siding ___.
- A. are nailed at the bottom of each piece
- B. cannot be applied vertically
- C. are available in sheets with interlocking grooves
- D. are available in only one width

_______________ 4. Metal exterior swinging doors are ___.
- A. filled with a wood core
- B. covered with wood veneer
- C. 2½″ thick
- D. filled with expanded foam

_______________ 5. Pediments appear on exterior elevations as ___.
- A. ventilators
- B. door trim
- C. flashing
- D. siding trim

_______________ 6. Window size shown on elevations refers to the ___.
- A. size of the glass
- B. size of the window frame
- C. size of the framed opening
- D. mullion dimension

_______________ 7. The hinged side of a door shown on an elevation is indicated with ___.
- A. object lines
- B. architectural notations
- C. hidden lines
- D. hinge drawings

_______________ 8. Roof pitch is noted on elevations with a ___.
- A. dimension for overall height
- B. slope diagram
- C. mathematical formula
- D. none of the above

_______ **9.** A three-tab composition shingle is made of ___.
- A. wood
- B. vinyl
- C. metal
- D. asphalt-impregnated materials

_______ **10.** Wood roof shingles are shown on elevations as ___.
- A. narrowly spaced lines
- B. small rectangles
- C. wavy lines
- D. hidden lines

_______ **11.** A type of metal roofing joint is a ___ joint.
- A. flat
- B. ribbed
- C. standing
- D. all of the above

_______ **12.** Flashing is used for ___.
- A. ornamentation
- B. structural support
- C. weatherproofing
- D. insulation

_______ **13.** Flutes refer to ___.
- A. handrails
- B. flashing
- C. windows
- D. vertical grooves

_______ **14.** Siding and roofing materials are estimated in ___.
- A. bundles
- B. pallets
- C. percentages
- D. squares

Matching

_______ 1. Commonly made of plastic

_______ 2. Narrow horizontal glass slats

_______ 3. Hinged at top

_______ 4. Cannot be opened

_______ 5. One window opens vertically

_______ 6. Windows at 5° angles

_______ 7. Two windows open vertically

_______ 8. Hinged at the bottom

_______ 9. Windows at 30° or 45°

_______ 10. Windows open horizontally

_______ 11. Hinged at side

A. double-hung
B. casement
C. single-hung
D. hopper
E. jalousie
F. awning
G. fixed
H. sliding
I. bay
J. skylight
K. bow

Identification

Identify the wood trim moldings.

_______ 1. Shingle mold

_______ 2. Dentil mold

_______ 3. Crown or bed mold

_______ 4. Brick mold

_______ 5. Water table

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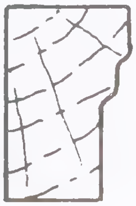

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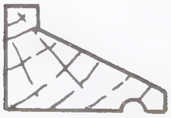

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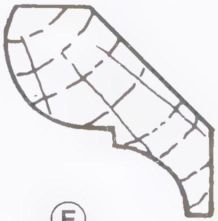


Identify the types of wood siding.

______________________ 6. Wood grain panel

______________________ 7. Beveled horizontal lap

______________________ 8. Angular

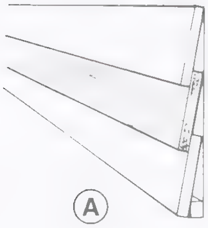
______________________ 9. Board-and-batten

______________________ 10. Stucco panel

______________________ 11. Tempered hardboard horizontal lap

______________________ 12. Rough-sawn panel

______________________ 13. Shiplap horizontal lap



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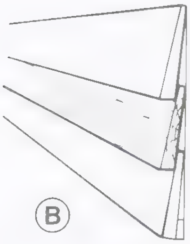

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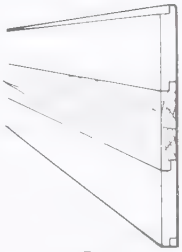

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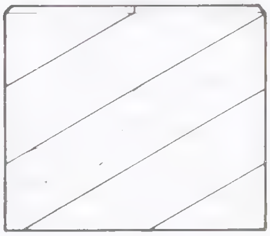

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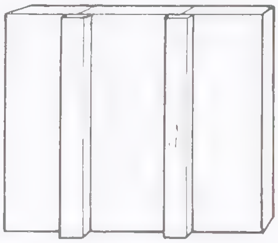


(H)

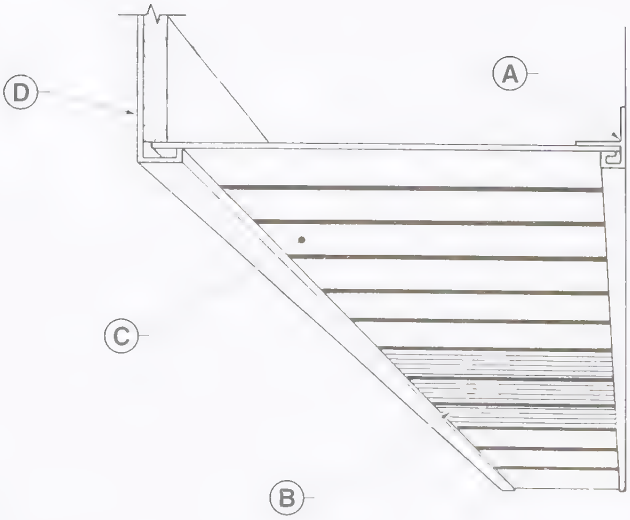
Identify the cornice components.

______________________ 14. Solid soffit

______________________ 15. Frieze runner

______________________ 16. Vented soffit

______________________ 17. Fascia cover



Identify the brick bonds.

______ **18.** Herringbone

______ **19.** End stacked

______ **20.** Common bond

______ **21.** Basket weave

______ **22.** Flemish bond

______ **23.** Horizontal stacked

______ **24.** Vertical stacked

______ **25.** English bond

______ **26.** Running bond

______ **27.** Garden wall bond

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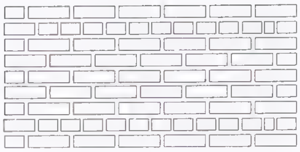

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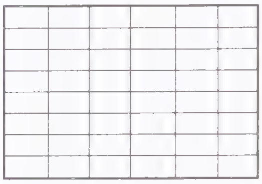

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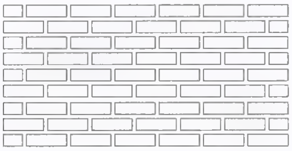

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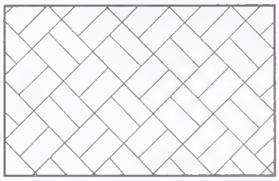

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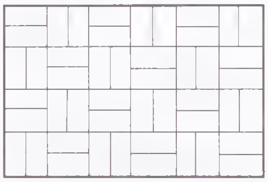

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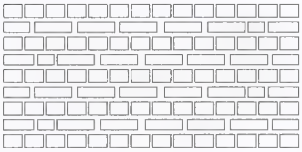

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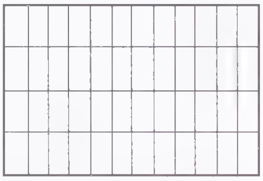

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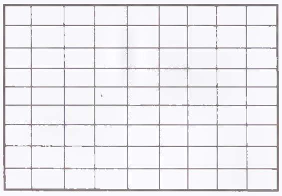

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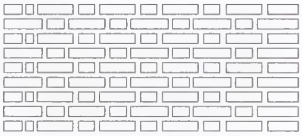

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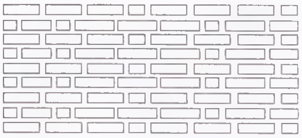


Identify the types of doors.

______ **28.** 10 light

______ **29.** 9 light crossbuck

______ **30.** 1 light

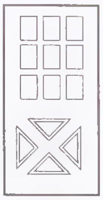
______ **31.** Flush

______ **32.** 3 light, 3 panel

______ **33.** Diamond light crossbuck

______ **34.** 6 light, 2 panel

______ **35.** 6 panel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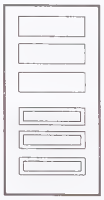
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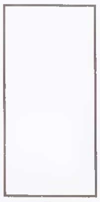
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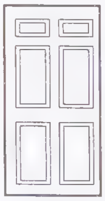
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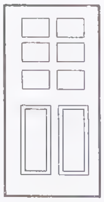
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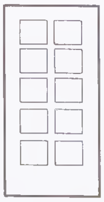
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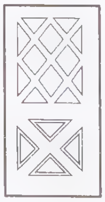
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Identify the types of windows.

_______________ **36.** Glass block

_______________ **37.** Awning

_______________ **38.** Bay

_______________ **39.** Fixed

_______________ **40.** Sliding

_______________ **41.** Bow

_______________ **42.** Skylight

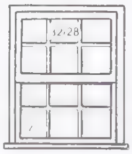
_______________ **43.** Double- or single-hung

_______________ **44.** Casement

_______________ **45.** Hopper

(A)

(B)

(C)


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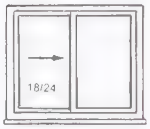

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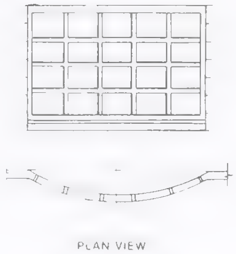

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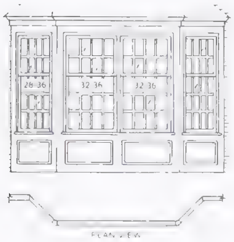

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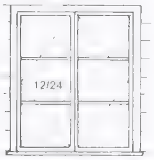

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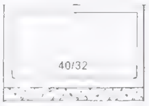

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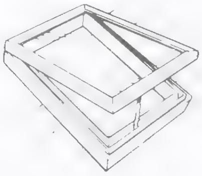

Identify the symbols shown.

_______________ **46.** Glass

_______________ **47.** Roof shingles

_______________ **48.** Wood panel

_______________ **49.** Sheet metal

_______________ **50.** Rubble stone

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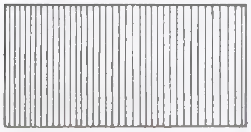

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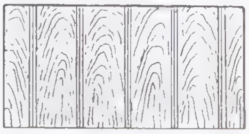

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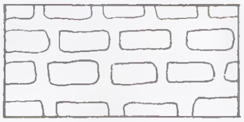

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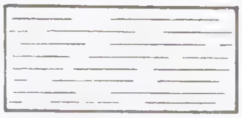


Identify the window components.

_______________ **51.** Light

_______________ **52.** Bottom rail

_______________ **53.** Top rail of sash

_______________ **54.** Stile of sash

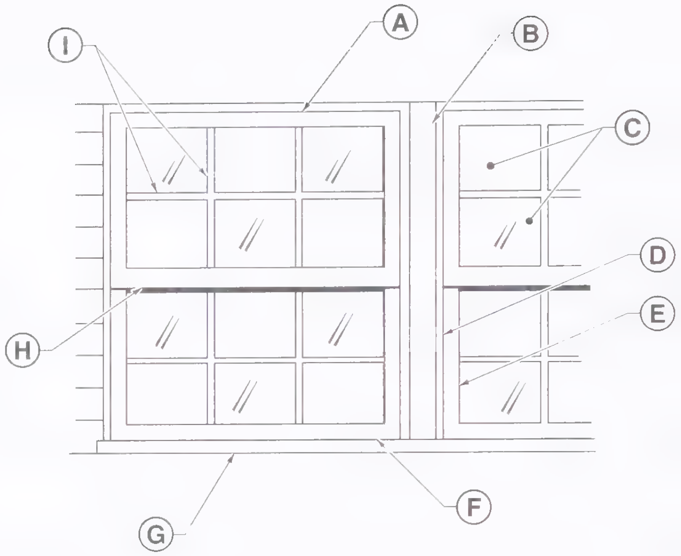
_______________ **55.** Jamb or frame

_______________ **56.** Muntin

_______________ **57.** Meeting rail

_______________ **58.** Mullion

_______________ **59.** Sill



Completion

_______________ **1.** Two types of soffit are ___ and ___.

_______________ **2.** The amount of siding or roofing material not covered by another course is called the amount of ___.

_______________ **3.** Wood panel siding is ___′ wide.

_______________ **4.** The type of wood used for wood shingles is ___.

_______________ **5.** Lintels over masonry openings are made of ___ and ___.

_______________ **6.** A(n) ___ secures the bottom of interlocking siding sheets onto exterior walls.

_______________ **7.** Glass installed in an exterior door is called a(n) ___.

_______________ **8.** ___ doors are raised in a track with springs.

_______________ **9.** ___ are vents with horizontal slats.

_______________ **10.** A(n) ___ is a roof projection that increases the amount of living space.

_______________ **11.** Openings formed in the bottom of gutters allow for the attachment of ___.

_______________ **12.** A built-up roof area that diverts water away from chimneys and other vertical roof projections is a(n) ___.

_______________ **13.** A cupola is installed on the ___ of the roof.

______________ 14. Two rooms that interior elevations are commonly used to show are the ___ and ___.

______________ 15. A standard modular brick covers approximately ___ sq ft.

______________ 16. The estimated amount of siding needed to cover a wall section 8′-6″ high by 24′-8″ long is ___ squares of siding.

Abbreviations

Provide the abbreviations for the following terms.

______________ 1. Aluminum

______________ 2. Board

______________ 3. Beveled

______________ 4. Brick

______________ 5. Built-up roofing

______________ 6. Casement

______________ 7. Clear glass

______________ 8. Composition

______________ 9. Door

______________ 10. Double-hung window

______________ 11. Downspout

______________ 12. Exterior

______________ 13. Flashing

______________ 14. Hollow metal door

______________ 15. Louver

______________ 16. Roofing

______________ 17. Rubble stone

______________ 18. Siding

______________ 19. Soffit

______________ 20. Shutter

______________ 21. Wrought iron

Printreading

Refer to the Front Elevation on page 183 for questions 1 through 16.

T F **1.** All windows on the front of the house are double-hung.

T F **2.** The house has two stories.

T F **3.** A splash block is to be installed at each downspout.

T F **4.** The double-hung windows are 24″ wide.

T F **5.** There are two luminaires (lighting fixtures) on the front of the house.

__________ **6.** The front doors are ___ doors.
- A. flush
- B. 6 panel
- C. sliding glass
- D. overhead

__________ **7.** Masonry materials shown include ___.
- A. brick
- B. concrete
- C. rough stone
- D. all of the above

__________ **8.** Siding on the house is applied ___.
- A. vertically
- B. horizontally
- C. on an angle
- D. none of the above

__________ **9.** The top rail of the picket fence is a ___.
- A. 1 × 4
- B. 1 × 6
- C. 2 × 4
- D. 4 × 4

__________ **10.** What size and type of material is applied at either side of the front door?

__________ **11.** The roof pitch has a(n) ___″ unit rise and ___″ unit run.

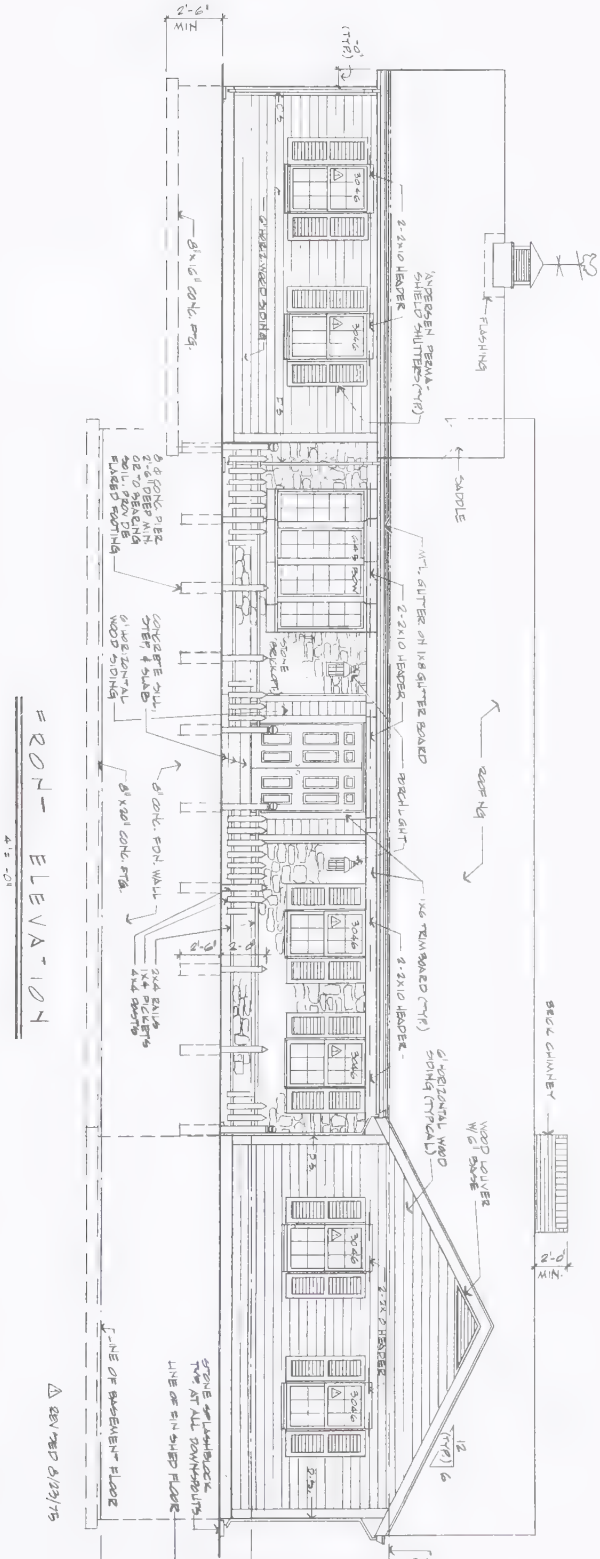
__________ **12.** The basement floor is ___ below the first-floor level.

__________ **13.** How many shutters are on the front of the house?

__________ **14.** Hidden lines around the cupola indicate ___.

__________ **15.** The minimum depth for the front porch piers is ___.

__________ **16.** The depth of the concrete foundation footing is ___″.


FRONT ELEVATION
SADDLE
FLASHING
BRICK CHIMNEY
PORCH LIGHT
2-2x10 HEADER
1x6 TRIM BOARD (TYP.)
8'-7"
8'-1

Identification

Identify the roof designs.

______ 1. Mansard

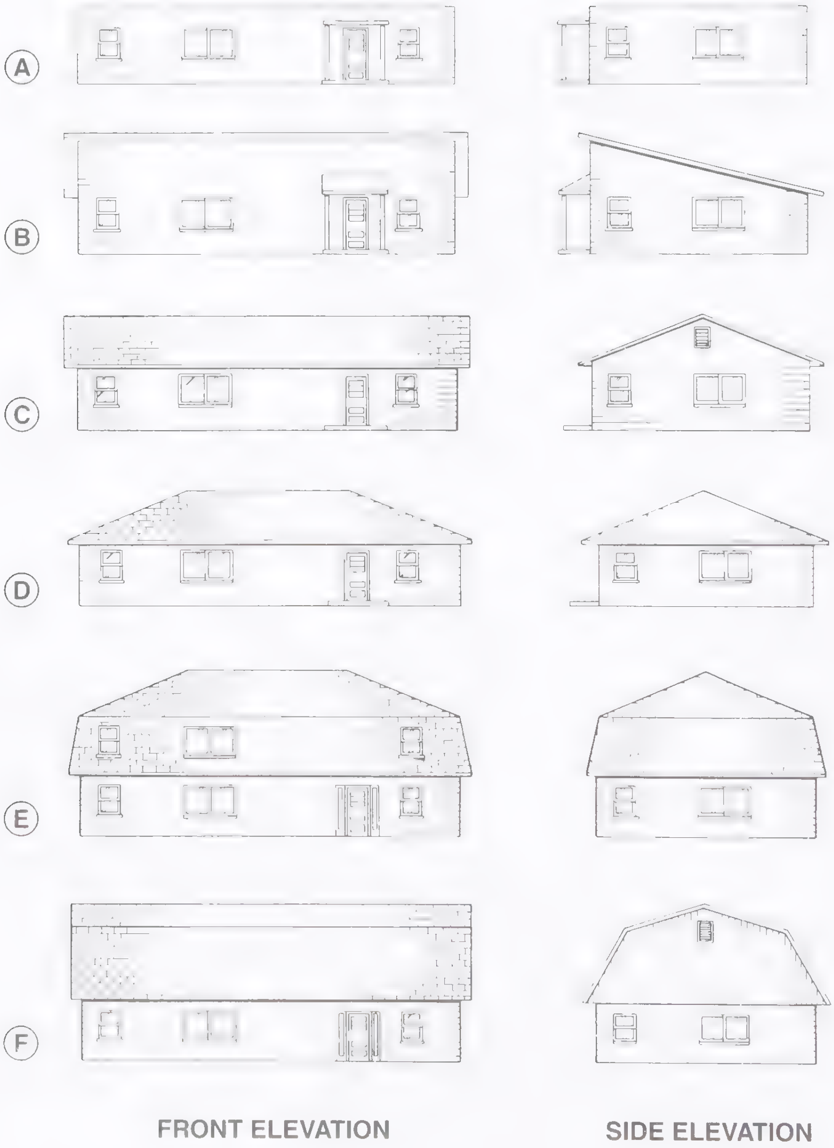
______ 2. Gable

______ 3. Shed

______ 4. Gambrel

______ 5. Flat

______ 6. Hip



Chapter 9

Floor Plans

Floor plans provide information about the interior of the house, including room layout, floor and wall openings, and interior finishes. Construction materials for interior partitions and exterior walls are shown with symbols and architectural notations. The name of each room is indicated on the floor plan. Locations for electrical devices and luminaires, plumbing fixtures and appliances, and heating and air conditioning ducts appear on floor plans. On center spacing of framing members is noted on a floor plan.

Floor plans are created from a cutting plane taken approximately 5′-0″ above floor level. All items below the cutting plane are shown with object lines. Items above the cutting plane that an architect needs to show are represented with hidden lines. Each story of a house is shown with a separate floor plan. For example, a two-story house has two floor plans. Dimensions on floor plans help in estimating amounts of both interior and exterior construction materials.

HORIZONTAL DIMENSIONS

All exterior walls and interior partitions are dimensioned on floor plans. See Figure 9-1. Floor plans for residential prints are commonly drawn at ¼″ = 1′-0″ scale. Extension and dimension lines show the horizontal locations for items and building features. Dimensions on floor plans are expressed in feet, inches, and fractions of an inch.

Several sets of dimension lines are shown on floor plans. The dimension line nearest the house provides dimensions for window and door openings. Dimension lines farther away from the house provide dimensions for other items and features.

Floors

Dimension lines farthest from the object lines of the house show the overall dimensions of the house. The subfloor framing, including the plates, joists, header joists, and subfloor covering material, or the slab-on-grade is constructed to the overall dimensions. Subfloor dimensions are checked for accuracy and square by measuring across diagonal corners or using the 3-4-5 method. For multistory houses, the sizes and on center spacing of the floor joists above the story shown are indicated. An arrow indicates the proper direction of joist installation.

Walls

The overall floor dimensions are equal to the exterior wall measurements. Locations for interior partitions are shown with dimension lines. Location dimensions for interior partitions originate from the outside of exterior walls. Extension lines for interior partition dimension lines may extend either to the face or center of the interior partitions.

The thickness of exterior walls and interior partitions is shown on floor plans with dimension and extension lines. See Figure 9-2. Wall and partition thickness is measured from face-to-face, that is, from the outside of the finish material on one side of the wall or partition to the outside of the finish material on the other side. For example, an interior partition framed with 2 × 4s (3½″ actual thickness) and covered with ½″ gypsum board on each side is shown on a floor plan as 4½″ thick.

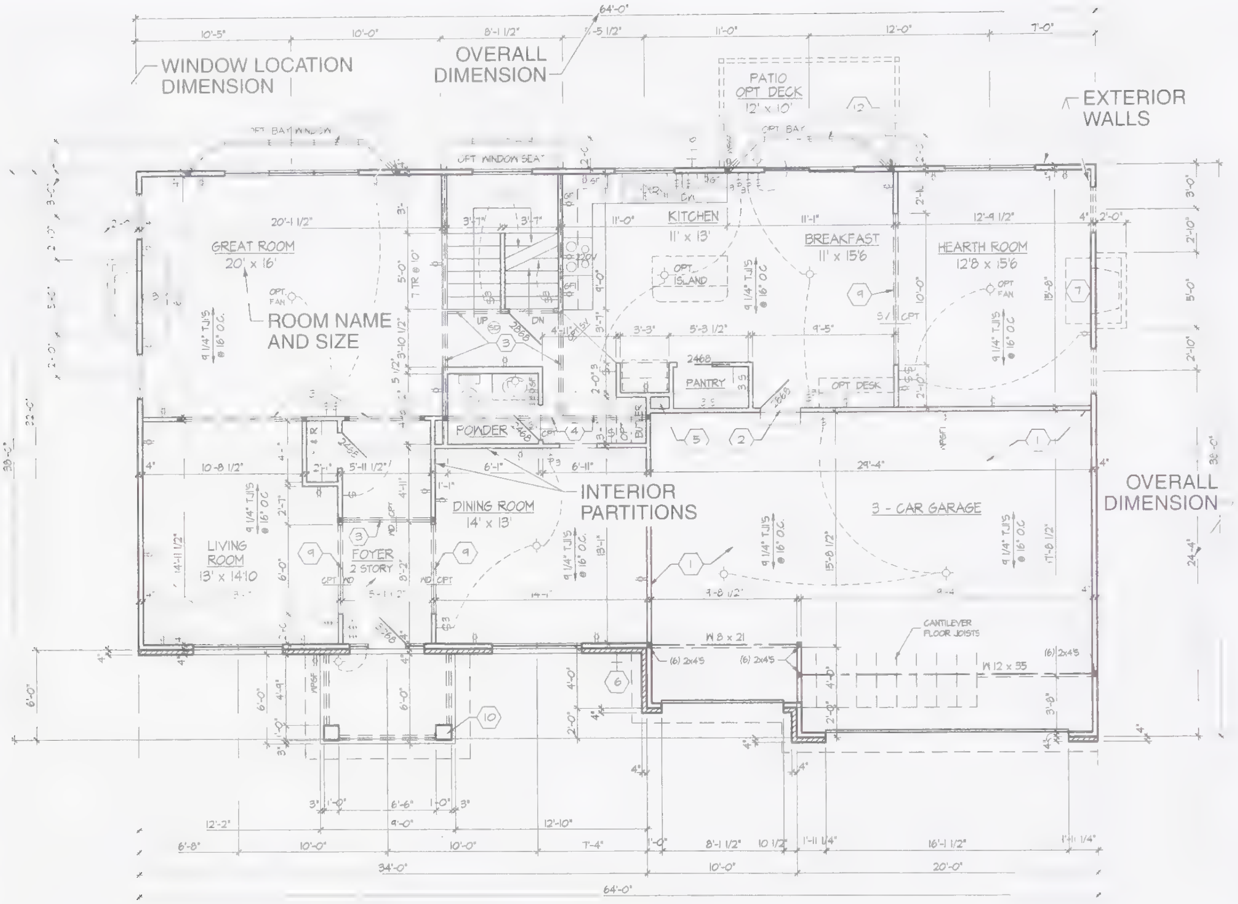


Figure 9-1. Floor plans show exterior and interior dimensions with a horizontal cutting plane taken approximately 5′-0″ above floor level.

Exterior walls are typically thicker than interior partitions due to the application of exterior wall finish materials and also because additional room may be needed for insulation installation. In wood- and metal-framed exterior walls, insulation is installed between the studs. Thicker walls filled with the proper insulation provide more resistance to heat and cold transmission. Exterior walls are framed with wider members, such as 2 × 6 plates and studs. Another method of increasing wall thickness is to lay out the studs in an offset pattern on the bottom plate. Offset studs also provide better sound insulation because the transmission of vibrations through the wall is limited.

Interior partition thickness may vary in situations where thicker partitions are needed for placement of plumbing pipes and heating and air conditioning ducts or where additional sound insulation is needed. Plumbing partitions may be 6″ to 8″ thick or thicker, depending on the space required for pipes.

OPENING INFORMATION

Locations, sizes, types, and finishes are shown for door, window, and pass-through openings. The size is shown at each opening, or a code letter or number appears near the opening on the floor plan that refers to a door or window schedule.

The sound transmission coefficient (STC) indicates the resistance of a wall, floor, or ceiling to airborne noise such as speech or music. A high STC rating indicates more resistance to airborne noise transmission than a low rating. The materials and methods used to construct walls, floors, or ceilings affects the STC rating. Acceptable STC ratings range from 39 to 65.

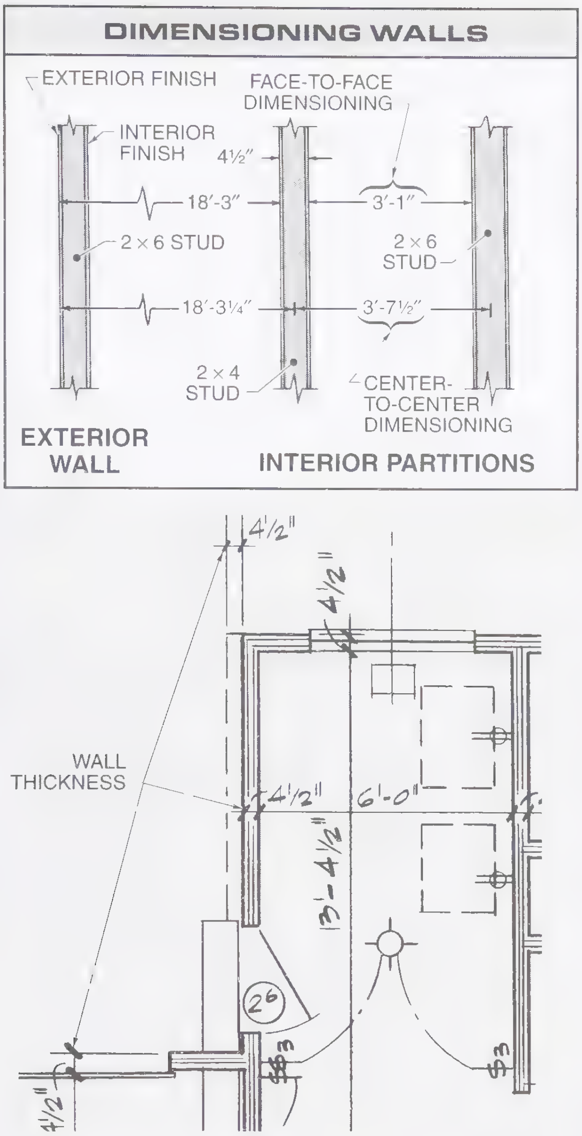
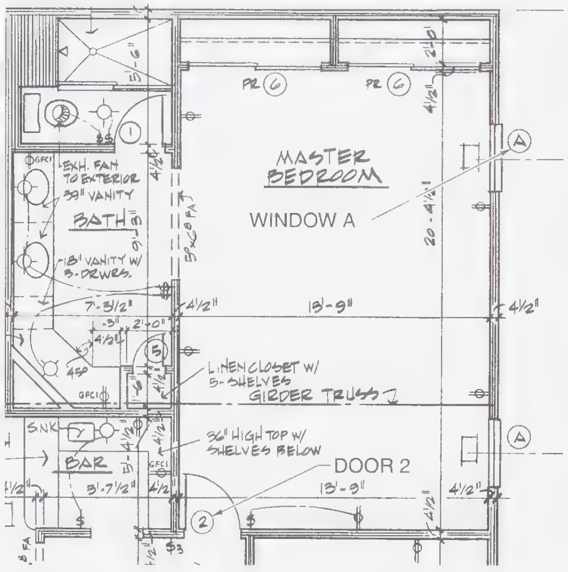


Figure 9-2. Wall location and thickness may be indicated using several methods.

in Figure 9-3 there are two door openings on the floor plan identified as number 6 doors, which are of the same size and type.



DOOR SCHEDULE

CODE	SIZE	TYPE	REMARKS
①	2′-4″ × 6′-8″ × 1⅜″	FLUSH	HOLLOW-CORE
②	3′-0″ × 6′-8″ × 1⅜″	FLUSH	HOLLOW-CORE
③	3′-0″ × 6′-8″ × 1¾″	PANEL	SOLID-CORE
④			

WINDOW SCHEDULE

CODE	SIZE	TYPE	REMARKS
Ⓐ	2′-4″ × 4′-8″	SINGLE-HUNG	INSUL. GLASS
Ⓑ	4′-1″ × 4′-0″	SINGLE-HUNG	INSUL. GLASS

Figure 9-3. Letters and numbers at openings shown on floor plans relate to door and window schedules.

Schedules

A schedule is a chart that shows the sizes and types of doors and windows in the house. See Figure 9-3. The schedule shows the width, height, and thickness of each door and window. The type of door or window and the finish are also indicated. Each door and window opening on a floor plan with a schedule is marked with a letter or number, contained in a circle or some other geometric shape. The letter or number refers to the information provided on the schedule. Similar openings with the same door or window type are noted with the same letter or number. For example,

Doors

Locations of interior and exterior door openings are shown on floor plans. The size of each door is indicated. The type of door is shown using an architectural notation or symbol at the opening or by a reference to a door schedule.

Types of doors in residential construction are classified by their methods of opening. Common residential door types include swinging doors, bypass doors, pocket sliding doors, bifold doors, multifolding doors, and overhead doors. Openings without doors (cased or finished openings) are also shown on floor plans.

Most residential interior doors are hollow-core doors. Solid-core doors are installed in areas where additional fire protection is required and as a safeguard against easy entry, such as between the house and an attached garage. Veneer for interior hollow-core and solid-core doors may be flush or molded to create the appearance of a panel door.

Swinging Doors. Swinging doors are shown on floor plans as an object line projecting from the edge of the opening, attached to the wall at one end. See Figure 9-4. The attached end of the swinging door symbol line indicates the location of the door hinges. An arc is drawn at the other end of the line indicating the door hand (direction of swing). Door hand for swinging door is classified as right-hand, left-hand, right-hand reverse, and left-hand reverse.

Wall openings are constructed in a manner to allow adequate room for the door and the door jamb. Most swinging doors are delivered to a residential job site as prehung units, with hinges mounted to the door and the prefabricated jamb. When ordering the type of swinging door to be installed, a left-hand door can be used for a right-hand reverse door. A right-hand door can be used as a left-hand reverse door. An exception to this is when two different faces are required on the door. For example, a finish is typically required on the exterior side that is different from the finish required on the interior side.

The core material of solid-core doors is usually particleboard or staggered wood blocks.

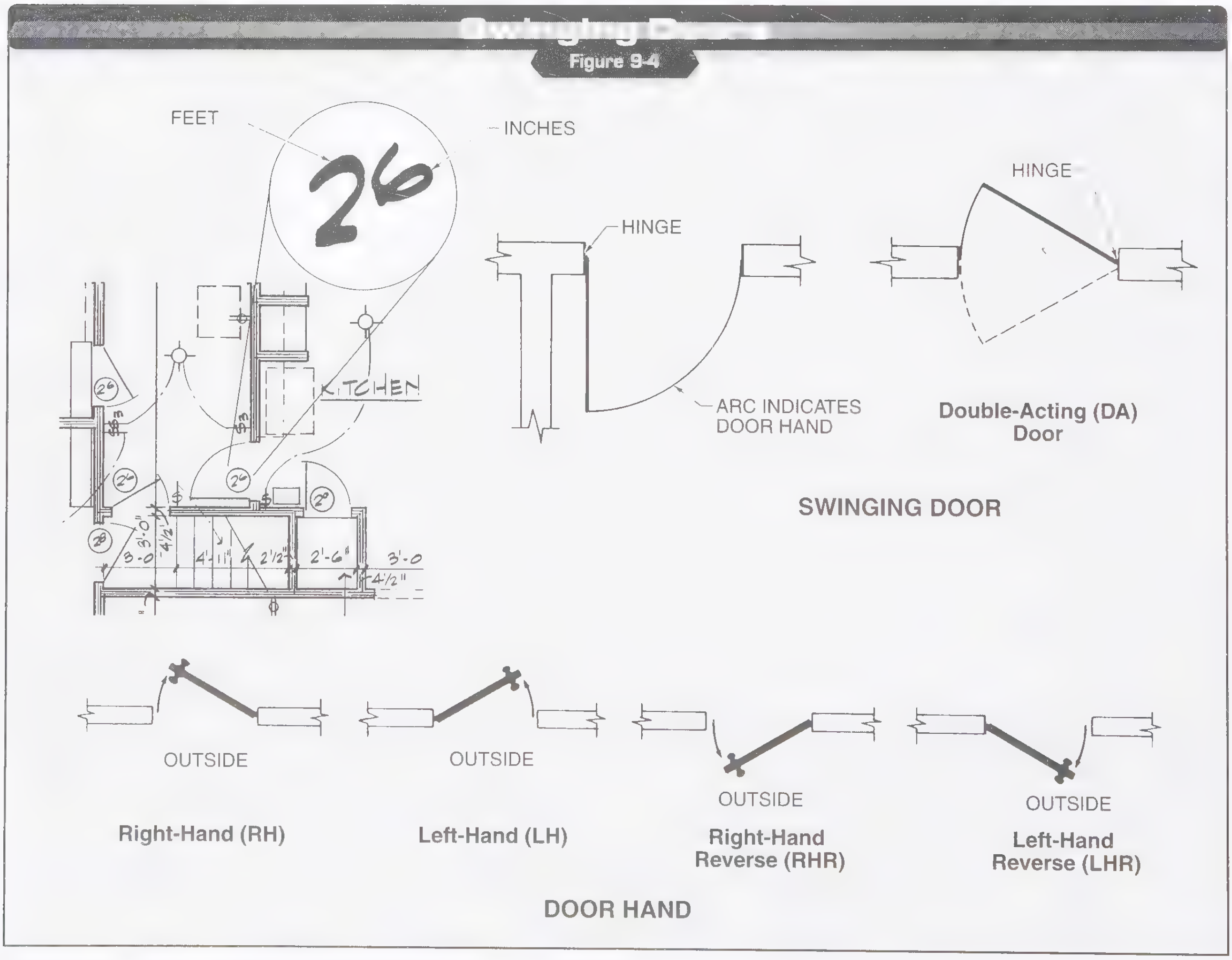


Figure 9-4. Door sizes may be specified in feet and inches at openings on the floor plan. Door hand refers to the direction of swing of a door.

Double-Acting Doors. Double-acting doors swing in both directions. A spring-loaded hinge that holds the door closed is attached to the bottom of the door or recessed in the floor. Double-acting doors may be installed between the kitchen and dining areas. On floor plans, two straight lines—one an object line and the other a hidden line—and an arc are drawn in both directions to indicate a double-acting door. An architectural notation is typically included to describe the door.

Bypass Doors. Bypass doors are commonly used in residential construction as interior closet doors and exterior sliding glass doors. Two object lines on floor plans indicate bypass doors.

For interior closet doors, a metal track is fastened along the top of the wall opening. Rollers are attached on the inside of the top of the doors. The doors are hung on the track and a small guide is mounted to the floor to keep the doors properly aligned. See Figure 9-5. Closet doors overlap approximately 1″ in the middle of the opening. Therefore, wall openings for sliding doors are made slightly smaller than the total width of the two doors combined. For example, an opening for two 3′-0″ closet doors would be 5′-11″.

For exterior sliding glass doors, refer to the door schedule and the specifications for door manufacturer information and the required opening size. Sizes for sliding glass doors vary based on the quality of the door and the type of frame.

Pocket Sliding Doors. Pocket sliding doors are sliding doors that are recessed inside a partition. A special opening, known as a pocket, is installed in the adjoining partition that is large enough to conceal the sliding door. A track and rollers similar to that for a closet door are installed for a pocket door.

On floor plans, a pocket (sliding) door is represented by a line extending into the partition at the side of the pocket door opening showing the location of the cavity and the sliding direction for the door. Pocket sliding doors are typically delivered to the job site as prehung units, with the track installed and the pocket framing prefabricated.

Bifold Doors. Bifold doors consist of pairs of folding doors in which only one door is hung from the jamb. The second door is hinged to the first door and is further supported by a roller that slides along a track mounted to the head jamb. The track installed at the top of the opening guides the door movement. Some bifold doors may include two or more pairs of doors. Bifold doors are shown on floor plans in a partially open position as a "V" attached to the wall at one end. The finished opening size is constructed slightly larger than the width of the door units to allow room for the door pivot.

Pocket sliding doors require special wall framing to allow the door to slide inside a partition.

Multifolding Doors. Multifolding doors, also known as accordion doors, consist of many narrow vertically hung panels held together with strips of metal, vinyl, or small springs. Multifolding doors can also be made of one continuous vinyl sheet. Multifolding doors have rollers installed along the top of the door that hang in a track fastened to the top of the opening. A track is not required at floor level. Multifolding doors may be attached to the wall at one side or provided with a latch to allow for opening at either end.

Multifolding doors are shown on floor plans as wavy lines. Wall openings for multifolding doors are constructed to the same size as the door. For example, where a 5′-0″ wide multifolding door is indicated, the opening is constructed 5′-0″ wide including the jamb.

Overhead Doors. Overhead doors are noted on residential floor plans with straight object lines. The width and height of the door are noted. Overhead doors are most commonly installed for exterior garage openings.

Interior Openings. Openings in interior partitions that do not receive a door are shown on floor plans with hidden lines across the opening or with no lines. Hidden lines across the opening indicate a header. The bottoms of headers for interior openings are commonly constructed to the same height as the other door openings, unless otherwise noted by the architect. A break in an interior partition without lines indicates a hallway opening without a header.

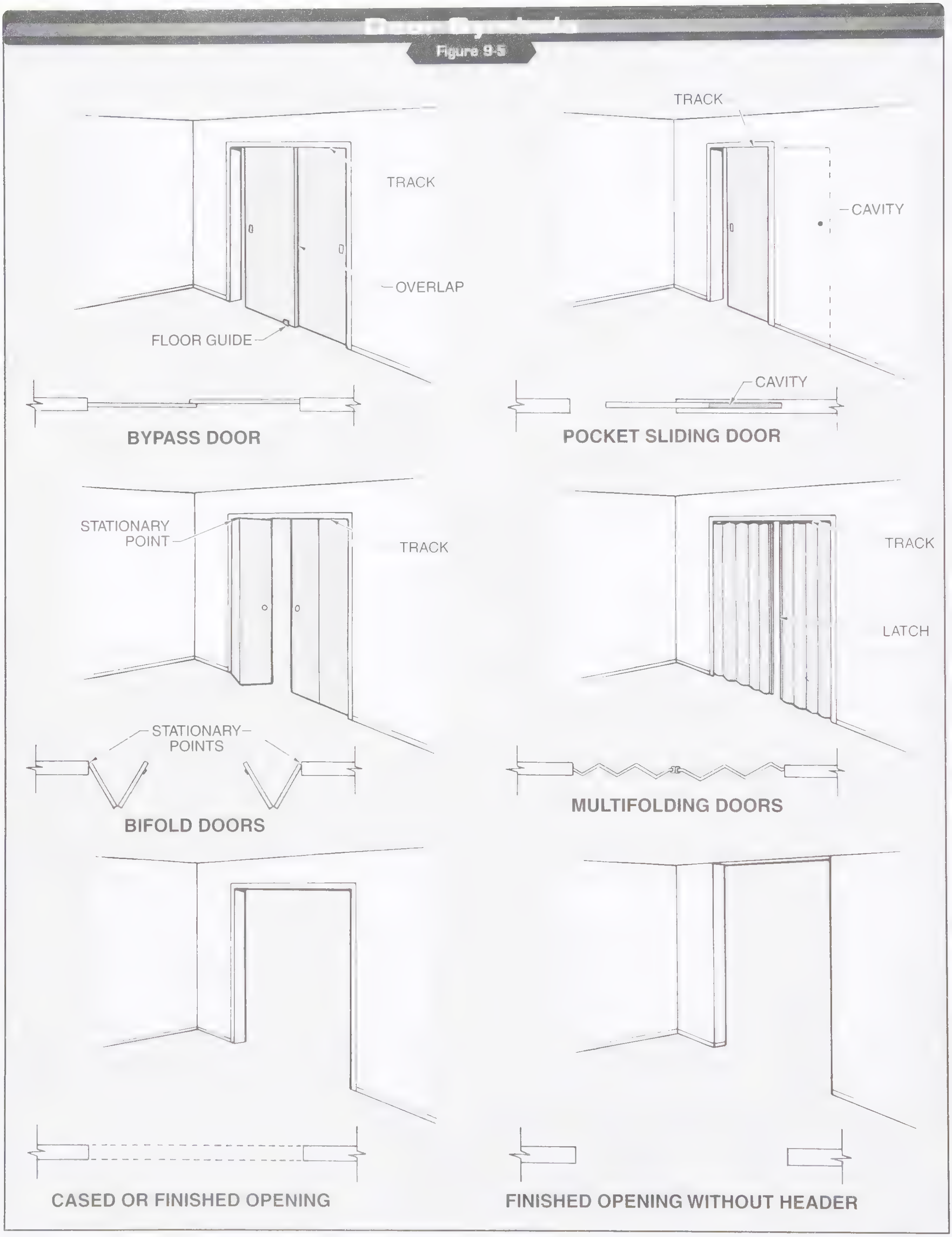
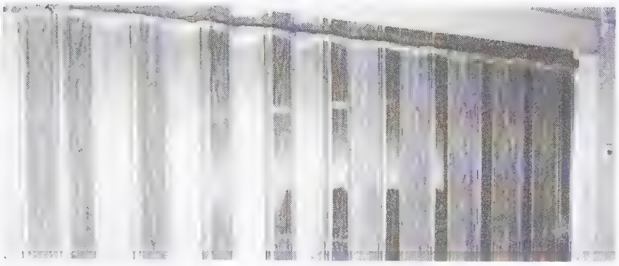


Figure 9-5. Symbols on floor plans represent door and opening types.



Multifolding doors consist of many narrow vertically hung panels held together with metal or vinyl strips or small springs.

Location. Exterior door locations are shown on floor plans with centerlines. Centerlines project from the house object lines and intersect the dimension lines along the exterior of the house. Door placement dimensions are indicated from the centerlines to a house corner or another house feature in feet, inches, and fractions of an inch.

All interior door locations may not be dimensioned on floor plans. Where location dimensions are not provided, the tradesworker determines the door location by centering the door between adjacent walls, locating the door as close to an adjoining wall as possible while still leaving an allowance for a jamb and trim members, or scaling the floor plan.

Size. Door width may be noted on floor plans at each opening. Door width is expressed in feet and inches. For example, a 30″ wide door is shown on a floor plan as a 2′-6″ door. The 2′-6″ dimension is noted in a circle at the door opening. The door width shown on floor plans is the actual width of the door, not the width of the opening or the jamb.

Standard residential door height is 6′-8″. Standard exterior doors are 1¾″ thick. Exterior steel doors are 1⅜″ and 1¾″ thick. Standard interior doors are 1⅜″ thick. Door height and thickness dimensions are usually not shown on floor plans; rather, they appear in schedules or the specifications. Special door thicknesses and heights may be noted on floor plans.

Windows

Cutting planes used to create floor plans pass directly through most windows in a house. Information on floor plans shows the exact location of each window opening. Various symbols show the types of windows. See Figure 9-6. For casement windows, the swing of the window is shown similar to a door. Mullions between windows are also shown on floor plans. Letters and numbers at window openings refer to a window schedule that provides additional window information.

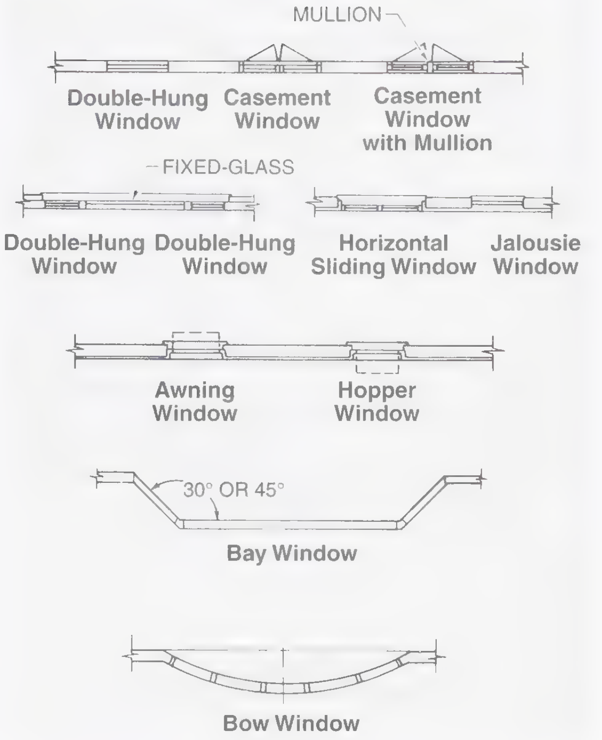


Figure 9-6. Symbols along exterior walls represent the type of window to be installed.

Location. Window opening locations are shown on floor plans with centerlines and dimension lines. See Figure 9-7. Centerlines extend from each window opening, originating at the exterior wall object lines. Continuous dimension lines from a corner of the house intersect the window centerlines. Dimensions to the center of each window opening are indicated in feet, inches, and fractions of an inch. Door locations may be noted along the same dimension lines.

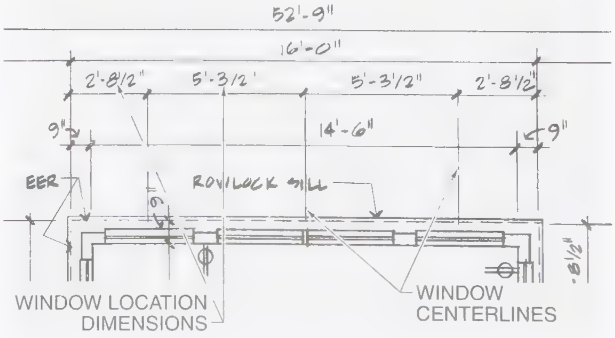


Figure 9-7. Centerlines intersecting dimension lines along the perimeter of a floor plan indicate horizontal window locations.

FLOOR LAYOUT

Where wood or metal framing members are used for floor construction, the layout of the framing members is determined from the floor plan. The layout of wood and metal framing members is based on the sizes and types of building components. Conventional or trussed framing members are used for framing floors. Stairway openings and areas under interior load-bearing partitions require special framing.

Conventional Framing

Wood-framed houses constructed of sill plates attached to a foundation, solid wood joists, header joists, and a plywood or oriented strand board (OSB) subfloor represent the most common conventional floor framing method. See Figure 9-8. Floor joist size and spacing for upper floors of a house are indicated on the floor plans of the lower floor. Floor joists are typically 2 × 8s, 2 × 10s, or 2 × 12s. The spacing of floor joists is based on anticipated loads. Floor joists are commonly spaced 16″ or 24″ OC. Blocking and additional joists may be installed under load-bearing partitions to provide extra support.

Figure 9-8. Two types of floor framing are solid lumber and trusses.

Subfloor panels are installed with the longer edge at a right angle to the floor joists. The panels may have square or tongue-and-groove edges.

Trussed Framing

Dimensions and spacing of prefabricated wood or metal floor trusses are also shown on the floor plans. As with conventional framing, additional trusses or blocking may be installed under interior load-bearing partitions.

STAIRWAYS

Openings for interior and exterior stairways appear on floor plans. The direction of travel on the stairway is indicated with an arrow on the stairway. Abbreviations or notations, such as "UP" or "DN," may be shown next to the arrow to indicate the direction of travel of the stairway. The types and locations of handrails are also shown. Dimension lines from exterior walls and interior partitions provide the locations for stairway openings. See Figure 9-9.

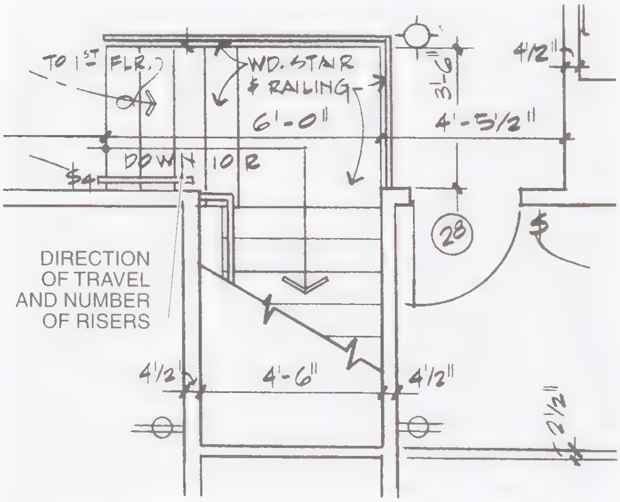


Figure 9-9. Stairway locations and the number of risers for each stairway are shown on a floor plan.

Stairway Openings

The width and length of the stairway opening is dimensioned on the floor plan in feet, inches, and fractions of an inch. For circular stairs, the diameter or radius of the stairway is indicated.

The minimum width for residential stairway openings is 36″ to accommodate egress (exit) in the case of an emergency and to provide easier movement of furniture and appliances into and out of the house. Per the *International Residential Code,* a stairway must not have a vertical rise of more than 12′ between floor levels of landings. Landings must be at least as wide as the stairway and must extend a minimum of 36″ in the direction of travel of the stairway.

The length of a stairway opening is determined by the amount of headroom required for the stairway. Minimum headroom for all parts of an interior and exterior residential stairway is 6′-8″.

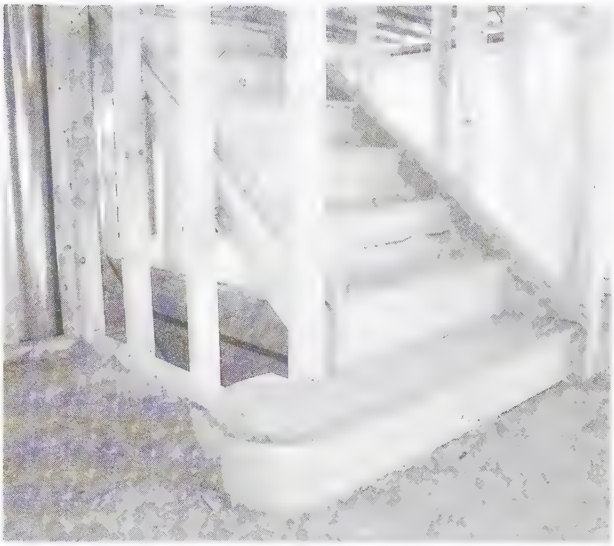
Treads and Risers

Stairway components include stringers, treads, risers, and handrails. Stringers, also referred to as carriages, are the members that support the treads and risers. There are at least two stringers for a stairway. Two types of stairway stringers are open and closed. Open stringers are cut to the proper dimensions for treads and risers. The treads and risers are fastened to the cut edges of the stringers. Closed stringers are routed out to receive the treads and risers. Cleats and/or wedges may be used to reinforce the treads and risers.

Treads are the horizontal portions of a stairway on which a person walks (steps). All tread depths in a stairway are equal. Per the *International Residential Code,* the minimum tread depth is 10″ and the greatest tread depth should not exceed the smallest tread depth by more than ⅜″.

Risers are the vertical portions of a stairway. Risers may be open or closed. Open risers have exposed stringers; closed risers cover the face of the stringers below the treads. All riser heights within a stairway are equal. Per the *International Residential Code,* the maximum riser height should be 7¾″ and the greatest riser height should not exceed the smallest riser height by more than ⅜″. Some local building codes provide a stair ratio for proper calculation of tread depths and riser heights. For one common stair ratio, the sum of one tread depth and one riser height should be greater than 17″ but less than 18″ ($T + R = 17''$ to $18''$). For another common stair ratio, the sum of one tread depth and two riser heights should be greater than 24″ and less than 27″ ($T + R + R = 24''$ to $27''$).

The number of risers in a stairway is indicated on a floor plan by a number along the stairway direction-of-travel arrow, followed by the abbreviation for riser (R). There is always one less tread than risers in a stairway. For example, a notation of "13R" on a floor plan indicates a stairway with 13 risers and 12 treads.



Per the International Residential Code, *minimum tread depth is 10″ and maximum riser height is 7¾″.*

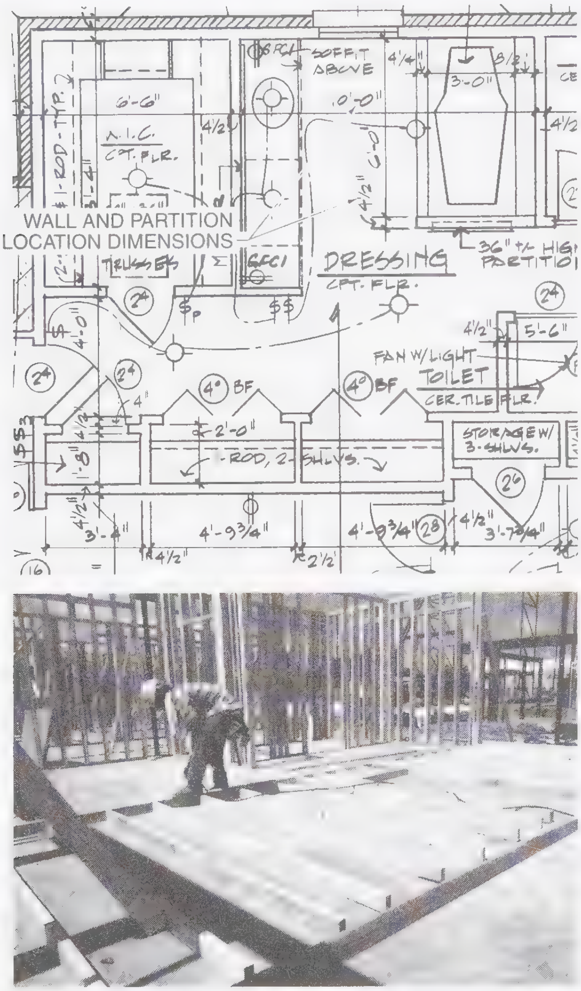
To determine the riser height (unit rise), the number of risers noted on the floor plan is divided into the total rise (overall vertical distance from floor to floor). For example, a stairway with a total rise of 8′-11″ is noted on the floor plan as having 15 risers. The total rise is converted to inches [$(8' \times 12'') + 11'' = 107''$]. The total rise is divided by the number of risers ($107'' \div 15 = 7.13''$). The decimal part of the inch is converted to the nearest sixteenth of an inch ($.13 \times 16 = 2.08$, rounded to 2). The unit rise is 7⅛″ (the fraction reduced from ²⁄₁₆″).

WALL LAYOUT

Floor plans provide the information needed to construct exterior walls and interior partitions at the proper locations and to the correct lengths. See Figure 9-10. Various symbols depicting construction materials used to construct exterior walls and interior partitions are shown on floor plans.

Locations for wall and partition placement shown on the floor plan are laid out and marked on the subfloor. Chalk lines are snapped on the subfloor to indicate the wall locations. Bottom plates are set on these lines and cut to the proper length. Locations for studs, trimmer studs, cripple studs, and corner framing are marked on the plates.

Depending on the materials and construction methods, different building techniques are used at wall intersections and openings. Masonry walls are laid according to the chalk lines snapped on the subfloor.



Southern Forest Products Association

Figure 9-10. Dimension lines accompanied by feet and inch dimensions indicate wall locations. Wall and partition locations are marked on the subfloor.

Exterior Walls

Wood, masonry, and concrete are the most common construction materials for residential exterior walls. Construction methods at corners, door openings, and window openings vary for each of the materials.

Studs in exterior walls are commonly spaced 16″ OC to provide structural support for the roof and regularly spaced members for attaching interior and exterior finish materials. See Figure 9-11. With a 16″ OC layout, wall studs are installed at regular 4′ intervals, a common width for finish wallcovering materials.

Corners. Outside corners for wood-framed construction require framing provisions for attaching interior and exterior finish materials. A corner post constructed of several studs is installed at the outside corners. Short blocking may be installed between the corner studs to provide adequate framing width.

Masonry corners are the plumb reference points for setting the remainder of the masonry courses in the wall. An interlocking pattern ties together masonry unit walls that intersect at corners.

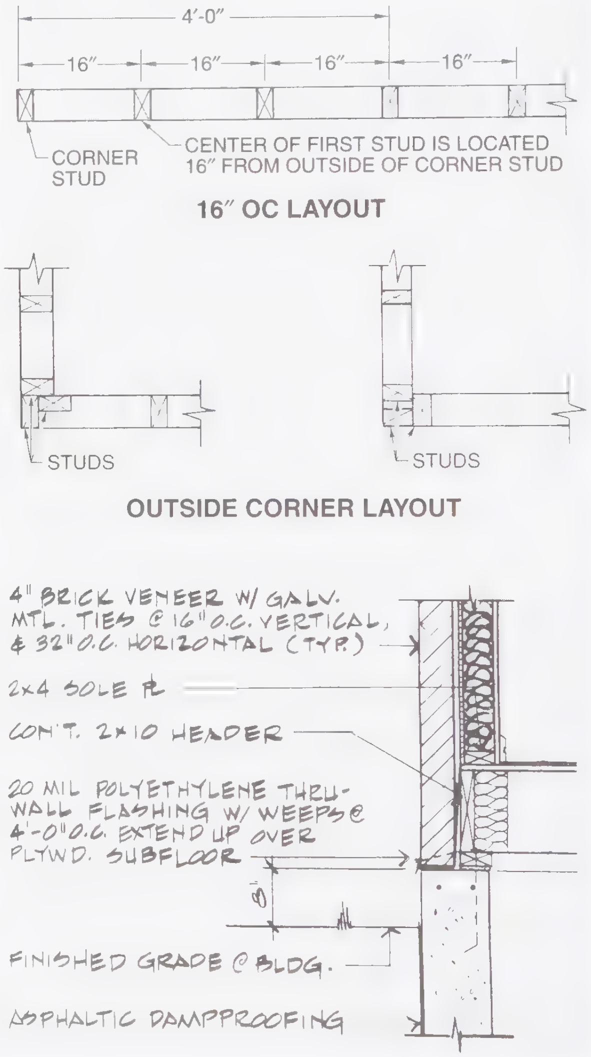


Figure 9-11. Exterior wall construction methods provide a means for attaching interior and exterior finish materials.

Door Openings. Layout for exterior door openings requires additional studs at each side of the opening to support the additional load. See Figure 9-12. For wood or metal framing, a common stud and a trimmer stud are placed at each side of the door opening. A wood or metal header transfers the weight from above the opening to the trimmer stud at each side.

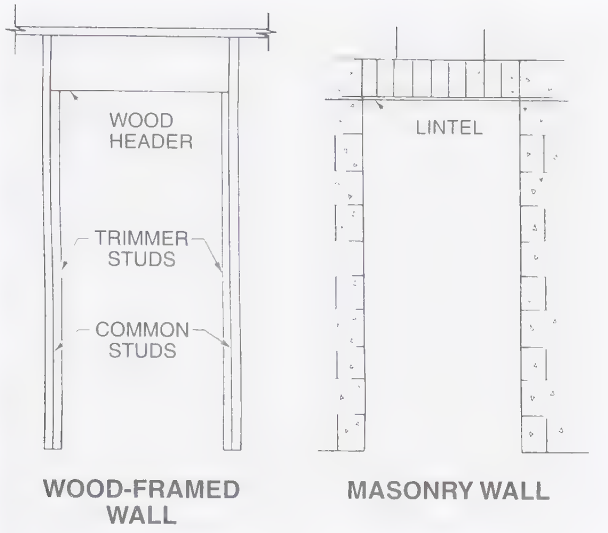


Figure 9-12. Door and window openings require additional support.

A steel angle or stone lintel above a door opening in a masonry wall transfers the load to the masonry units on the sides of the opening. A decorative course of brick may be laid above the opening. No additional masonry is required at either side of the opening. Wood jambs and doors are set in place after the masonry is laid. Metal door jambs are set in place and braced plumb before masonry is laid. Masonry is then set around the metal jamb.

Window Openings. Opening sizes for windows vary depending on the quality of the window and the manufacturer. Headers in wood- and metal-framed walls and lintels in masonry walls are installed for window openings in the same manner as door openings. The height of the window opening headers is the same as the door opening headers. Framing below a window includes a sill and cripple studs. A masonry sill of brick or stone is set at the bottom of a window opening.

Interior Partitions

Interior partition studs are commonly laid out 16″ OC similar to exterior framed walls. In some instances, interior partitions may be constructed with studs spaced 24″ OC. Interior partitions are classified as load-bearing or non-load-bearing. See Figure 9-13. Load-bearing partitions support loads above the partition. Non-load-bearing partitions serve only as dividers between rooms and have no structural purpose.

To determine whether a partition is load-bearing or non-load-bearing, the location and direction of placement for floor or ceiling joists is noted. Partitions constructed perpendicular to the direction of the joists and that support the joists are load-bearing partitions. Partitions that are parallel with the direction of the floor or ceiling joists and the perpendicular partitions that do not support any loads are non-load-bearing partitions. Interior partitions require different construction techniques for interior corners and openings.

Corners. Corners for intersecting interior partitions must be arranged so that interior finish materials can be properly attached. Additional studs and blocking are installed in partitions to provide proper support. For inside closet corners, additional studs provide the required support for shelf cleats and clothes rods.

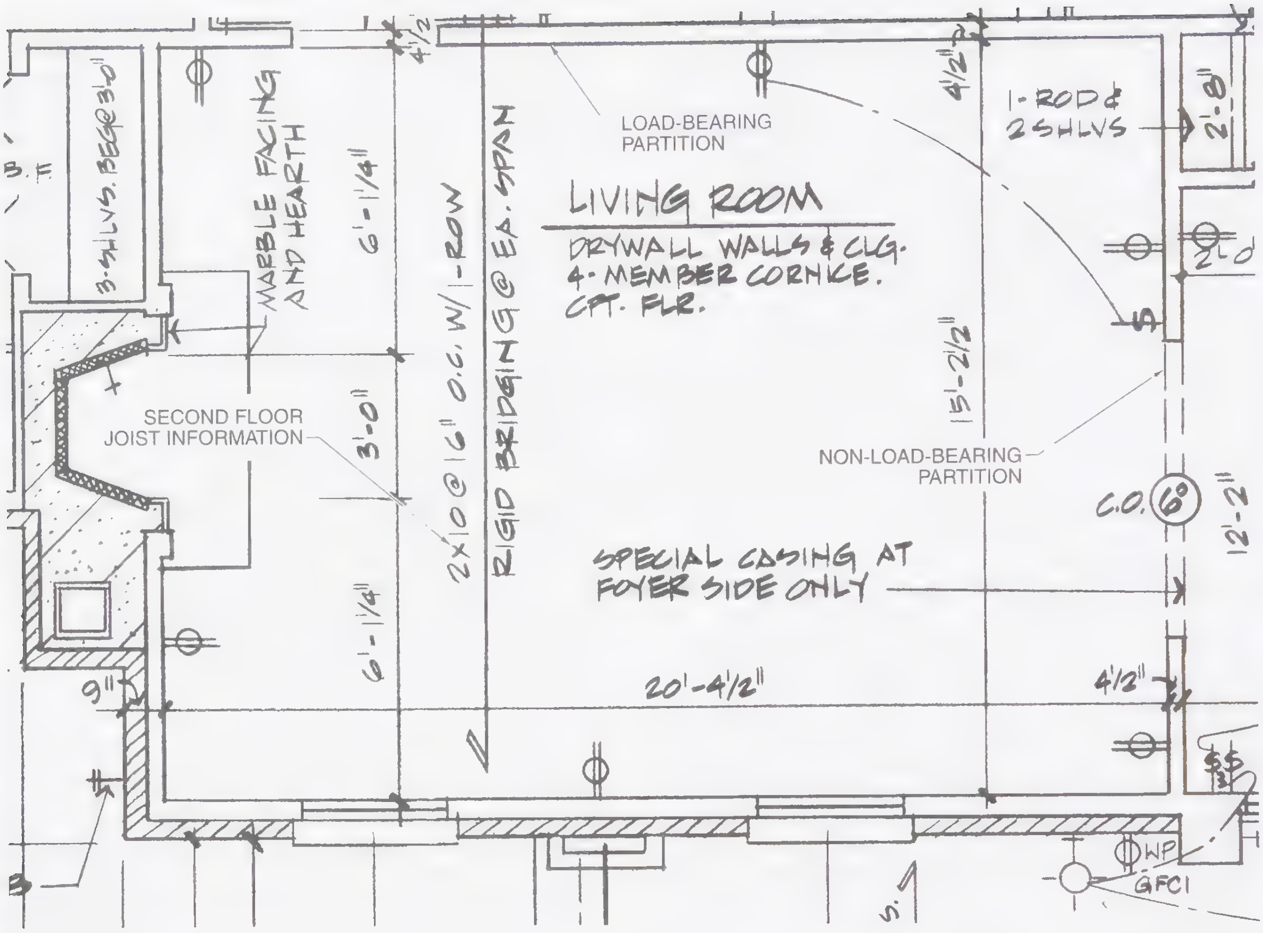
Door Openings. Construction at each side of interior wood- or metal-framed door openings requires a common stud and trimmer stud similar to exterior walls. Solid headers are installed only in interior load-bearing partitions. Non-load-bearing partitions have a single header with cripple studs over the opening. All masonry openings require a lintel.

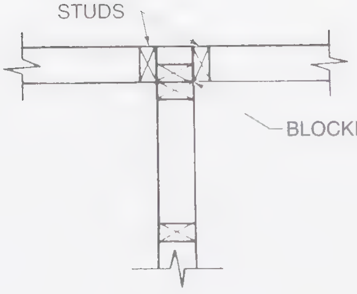
Prefabricated Walls

The layout and placement of prefabricated walls from a floor plan is different from that for job-built construction. A floor plan for prefabricated walls shows a series of letters and numbers that relate to markings on the prefabricated wall sections.

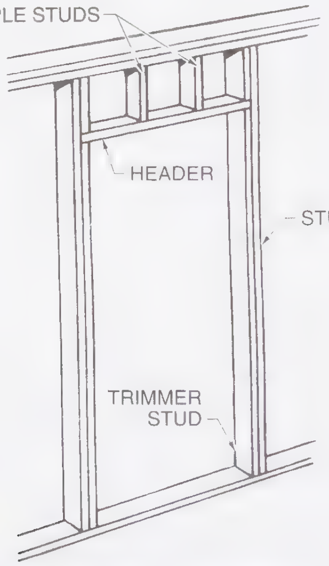
Layout. Wall layout for placement of prefabricated walls is shown on the floor plan with dimension and extension lines. Dimensions are expressed in feet, inches, and fractions of an inch. Wall locations are laid out on the floor just as for job-built walls. The layout of studs on plates is not required because the studs and plates are included as part of the prefabricated wall.

Prefabricated wall sections can be set in position with a crane.





WALL INTERSECTION FRAMING



OPENING FRAMING IN NON-LOAD-BEARING PARTITIONS

Figure 9-13. Joist direction typically determines load-bearing and non-load-bearing partitions. Non-load-bearing partitions have fewer structural requirements at openings than load-bearing partitions.

Placement. Prefabricated wall sections are marked with the same letters and numbers shown on the floor plan. Wall sections are set in place on the chalk lines with a crane or by hand. Walls are braced plumb and straight and attached to the floor. Intersecting walls are tied together to create a rigid framework for the house.

ROOF INFORMATION

Roof components are set in place after the exterior walls and interior load-bearing partitions are constructed, braced plumb and straight, and fastened to the floor. The floor plan for the top floor of a house contains information about the roof. See Figure 9-14. The type of roof construction is noted as either conventional framing or trusses. Arrows on floor plans indicate the direction of the roof framing members. The spacing of the framing components is indicated along the arrows.

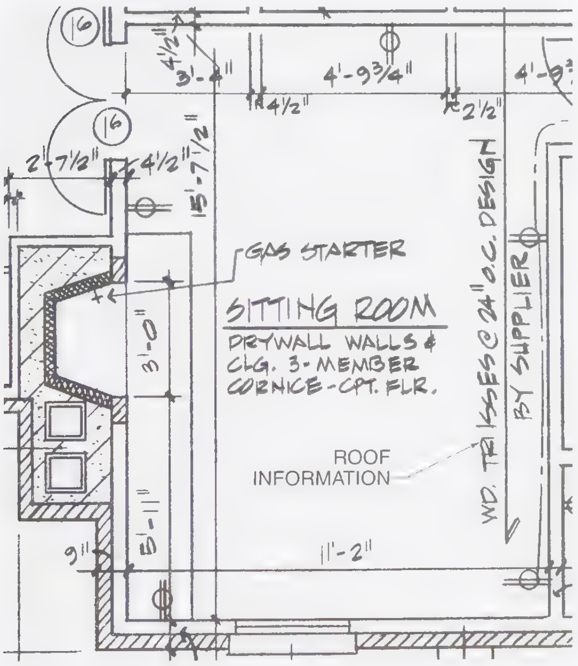


Figure 9-14. Roof framing member spacing and materials are noted on floor plans.

Conventional Roof Framing

Ceiling joists, rafters, and braces are the basic components for conventional roof framing. The sizes and spacing of the joists and rafters are noted on the floor plan. For complicated roofs, a separate plan view of the roof framing may be included in the set of prints.

The rooflines and roof finish material affect the overall appearance of a house.

Ceiling Joists. Ceiling joists are horizontal members that form the support for finish ceiling materials. Conventionally framed ceiling joists are typically spaced 16″ OC and rest on exterior walls and interior load-bearing partitions. Ceiling joists may be 2 × 6s, 2 × 8s, or heavier wood members, depending on the spans and loads. Additional braces may be installed on top of the ceiling joists to maintain their alignment and prevent them from twisting on long spans. Ceiling joist sizes, spacing, and direction are noted on the floor plan for the top floor of the house.

Rafters. Rafters form the sloping portion of a roof. On gable roofs, rafters are installed in the same direction as the ceiling joists. On hip roofs, rafters are parallel, perpendicular, and at an angle to the ceiling joists. The lumber used for rafters has basically the same dimensions as ceiling joists. Rafter size is based on spans and loads. Rafter sizes and spacing are noted on the top floor plan.

Truss Framing

The components of a roof truss form the ceiling joist, roof rafter, and braces. See Figure 9-15. Roof trusses are designed so that loads are transferred to the ends of the trusses, which typically bear on exterior walls. Interior load-bearing partitions are usually not required to support the trusses. Residential trusses are commonly spaced 24″ OC or as specified by the architect. Arrows and notations on the top floor plan indicate the truss direction and spacing.

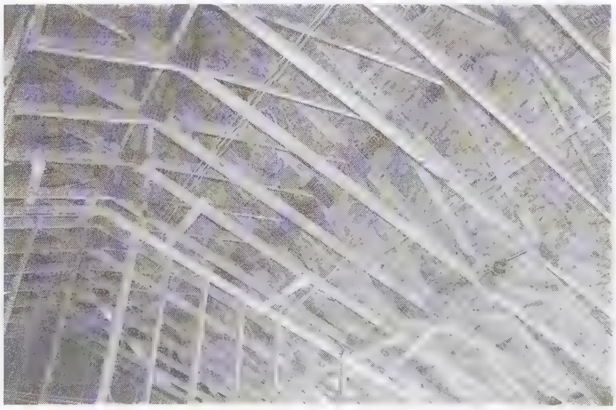


Figure 9-15. Truss roofs incorporate ceiling joists and rafters into one unit.

FINISH INFORMATION

Floor plans provide information about finish materials applied to interior floors, walls, and ceilings. See Figure 9-16. Two methods are used to indicate interior finish materials. In one method, finishes are noted on floor plans below the room name in the center of each living area or wherever there is enough space on the floor plan for the notations. The other method provides a schedule for room finish materials. A room finish schedule indicates the floor, wall, and ceiling finishes listed with the name of each room. Special finish molding may also be included in the notations.

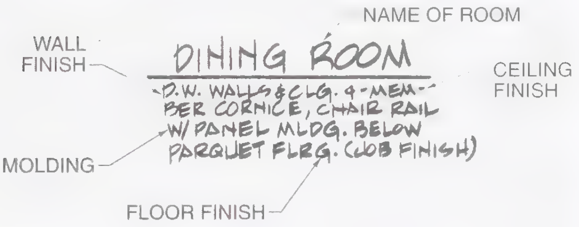


Figure 9-16. Room names are typically shown on floor plans to identify rooms. Finish materials may be indicated with architectural notations.

Floors

Residential finish floor coverings include carpet, hardwood, resilient coverings, laminate flooring, and tile. Finish materials are applied directly to the subfloor or to the underlayment, which is installed over the subfloor. Underlayment is particleboard, oriented strand board, plywood, or hardboard that provides a smooth surface under the finish floor material. The type of underlayment depends on the wear pattern, framing, and floor finish materials.

Carpet. Carpet is manufactured in a variety of styles using various methods. Carpet types include Axminster, tufted, Wilton, velvet, and knitted. The most common type of carpet for residential construction is tufted. Carpet fibers are punched into a prewoven backing fabric that is then coated with a latex compound to hold the carpet tufts in place. A foam pad may be placed on the subfloor before carpet installation to create a softer walking surface. Carpet is laid on the pad, stretched into place, and fastened to strips that are attached to the floor around the perimeter of the room.

Wood. The most common wood for hardwood flooring is oak. Oak is a hardwood that withstands a great amount of wear from walking traffic. Maple is another common hardwood used for residential flooring. Hardwood flooring is manufactured in many different patterns and finishes. See Figure 9-17. Two common categories of hardwood flooring are strip and parquet. Tongue-and-groove strips are narrow pieces of wood flooring from 2½″ to 6″ wide and ¾″ thick. Tongue-and-groove strips are attached to the floor in rows, each nailed, stapled, or glued into place. Parquet flooring is manufactured in various size squares that are glued to the floor.

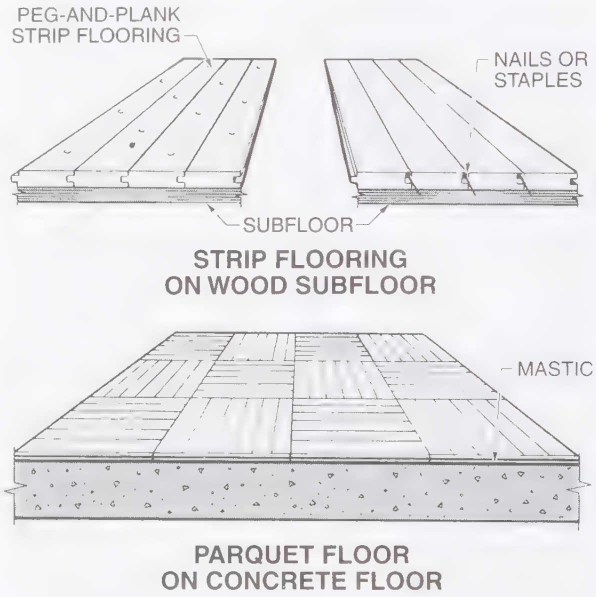


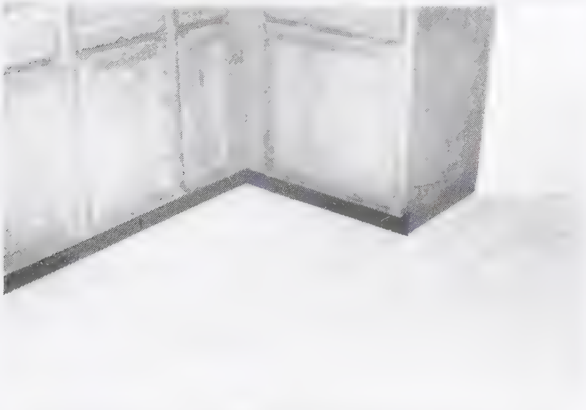
Figure 9-17. Hardwood strip flooring and parquet flooring are laid in different patterns and secured in place with fasteners or mastic.

Hardwood flooring is either prefinished or finished on the job site. Job-site finishing includes sanding, staining, varnishing, and waxing. The areas covered with hardwood flooring are noted on floor plans.

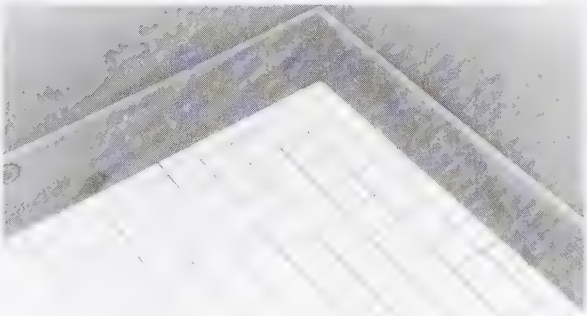
Resilient Coverings. Wide sheets or smaller squares of resilient floor covering materials are commonly installed in houses. Resilient finish flooring is commonly manufactured from vinyl material and is used in high-traffic areas or areas subject to moisture. See Figure 9-18. Resilient flooring is glued in place over smooth underlayment.

Laminate Flooring. Laminate flooring is available in a variety of designs, including simulated wood, stone, and tile. Each plank or tile consists of a transparent top layer, decorative layer, carrier layer, and bottom layer that are bonded together under extreme pressure and heat. The top layer and decorative layer, where the pattern is

placed, are plastic materials that provide excellent durability. The carrier layer is fiberboard or particleboard, and the bottom layer is a stiff paper-based material that provides additional support.



RESILIENT



CERAMIC

QUARRY

Figure 9-18. Resilient flooring and ceramic and quarry tile are common residential floor finish materials.

Laminate flooring has a tongue-and-groove design and is a "floating floor" that is not attached to the subfloor. Laminate flooring is generally less expensive than other finish flooring materials because it does not require significant subfloor preparation.

Tile. Ceramic, marble, clay, and quarry tile are installed in residential foyers, bathrooms, and kitchens. These materials are used because of their ability to withstand moisture and wear. Tile is set into a base of mastic or concrete. After the mastic or concrete has properly set, the spaces between the tiles are filled with grout. In some instances, a waterproofing material may be applied to the grout joint to complete the installation. The design and type of tile material to be installed is noted on floor plans in the areas covered.

Walls

Finish materials for interior residential walls include gypsum board, plaster, wood paneling, and ceramic tile. Wall finish materials are applied to framing members or masonry after the electrical, plumbing, and mechanical provisions are made inside the walls and partitions. Insulation is also installed in walls and partitions before wall finish materials are applied. A rough building inspection is typically required prior to covering the walls with interior finish materials. Without interior finish materials in place, easy access is provided to the local building inspector to ensure that all electrical, plumbing, and mechanical installations and all structural members are safe and constructed according to the applicable building codes.

Gypsum Board. Gypsum board, commonly known as drywall, is the most common interior residential wall and ceiling finish material. Pressed gypsum rock is covered with layers of treated paper or foil on both sides to create gypsum board panels. The paper covering is also wrapped around the long edges of the sheets. The gypsum is exposed on the ends. The paper covering may be waterproof and fireproof. See Figure 9-19. Gypsum board is available in 4′-0″ wide sheets that vary in lengths from 8′-0″ to 14′-0″. Gypsum board for residential construction is ⅜″, ½″, or ⅝″ thick. The longest edges of each sheet are tapered to allow for smooth filling of the joints between the pieces.

Metal corner beads, which reinforce outside corners of gypsum board walls, are installed with fasteners and covered with drywall joint compound.

Figure 9-19. The most popular residential interior wall and ceiling finish material is gypsum board.

Gypsum board is commonly installed in residential applications with the long edge perpendicular to the framing members. The gypsum board is fastened to the framing members with nails or screws. Nail or screw holes in the face of the gypsum board are filled with several layers of joint compound that is sanded to a smooth finish after it dries. Several layers of joint compound are applied to the edge joints and paper tape is embedded in the layers. After the joint compound sets properly, the joint is sanded to a smooth finish. Gypsum board is painted or covered with a wallcovering material such as wallpaper. Gypsum board is also installed as a backing for other wall finish materials.

Lath and Plaster. Metal or gypsum lath is fastened to interior studs and covered with plaster. Gypsum lath is similar to gypsum board but has a different face paper coating that bonds more efficiently to plaster. Plaster is installed in several coats and can be finished smooth or in a variety of rough textures.

Paneling. Paneling is made of solid wood, plywood with a face veneer, or a tempered hardboard wood product with a laminated or veneer face. See Figure 9-20. The paneling face may be unfinished wood or prefinished materials. Paneling can be smooth or vertically grooved. Interior residential wood paneling is typically 3⁄16″ thick and is commonly installed over gypsum board to provide additional strength.

Ceramic Tile and Stone. The durability of ceramic tile makes it a popular finish material for kitchen and bathroom walls. See Figure 9-21. Ceramic tile is manufactured as 4¼″, 6″, and larger size squares and also as paper-backed sheets with 1″, 2″, 2¾″, or 3″ tile squares attached. Several types of stone, such as granite or marble, are also used as interior wall finish. A waterproof gypsum board or cement board product is fastened to the framing members as a backing for the tile or stone. A layer of adhesive is applied to the face of the board, and the tile or stone is placed in position. Joints between the tile or stone are filled with grout or resin to prevent moisture penetration.

Plastic Laminate. Highly compressed plastic laminate panels may be installed on walls in kitchen and bathroom areas. Plastic laminate panels are available in 2′-0″ to 5′-0″ widths and in 5′-0″ to 12′-0″ lengths. Plastic laminate for vertical installation is approximately 1⁄32″ thick. Standard-grade plastic laminate for horizontal installation is approximately 1⁄16″ thick. Plastic laminate is adhered to particleboard, gypsum board, or other backing material with contact cement. Plastic laminate is also commonly applied to kitchen countertops and cabinets. Countertops may be post-formed (formed with rounded edges) or square-edged.

Ceilings

Gypsum board is the most common finish material for interior ceilings. After gypsum board panels are fastened to the ceiling, nail or screw holes and joints are finished in the same manner as gypsum board applied to walls. The gypsum board is typically painted for a finish. Small pieces of expanded foam, approximately 1⁄16″ to ¼″ in diameter, may be mixed into paint that is sprayed onto the ceiling to create a rough texture, providing additional sound insulation.

Tongue-and-groove or shiplap boards may also be applied as a ceiling finish. A board finish is usually installed in rooms with open ceilings higher than 8′-0″.

Structural and ornamental wood beams are also installed as ceiling finish trim. Locations and sizes of wood beams at the ceiling are shown on floor plans. For structural beams that support rafters and roof loads, gypsum board or other finish materials are fitted to the beams and the exposed wood is stained or painted. Ornamental (false) beams are made of expanded foam, solid wood, or several pieces of wood fastened together to create the appearance of a solid wood beam. Ornamental beams are set in place after the other ceiling finish materials are applied.

Cabinetry

Base and wall cabinets are shown on floor plans. See Figure 9-22. Cabinets set on the floor are base cabinets. Base cabinets are shown with object lines. Cabinets attached to the wall at or near the ceiling are wall cabinets. Since wall cabinets are above the cutting plane, they are shown on floor plans with hidden lines.

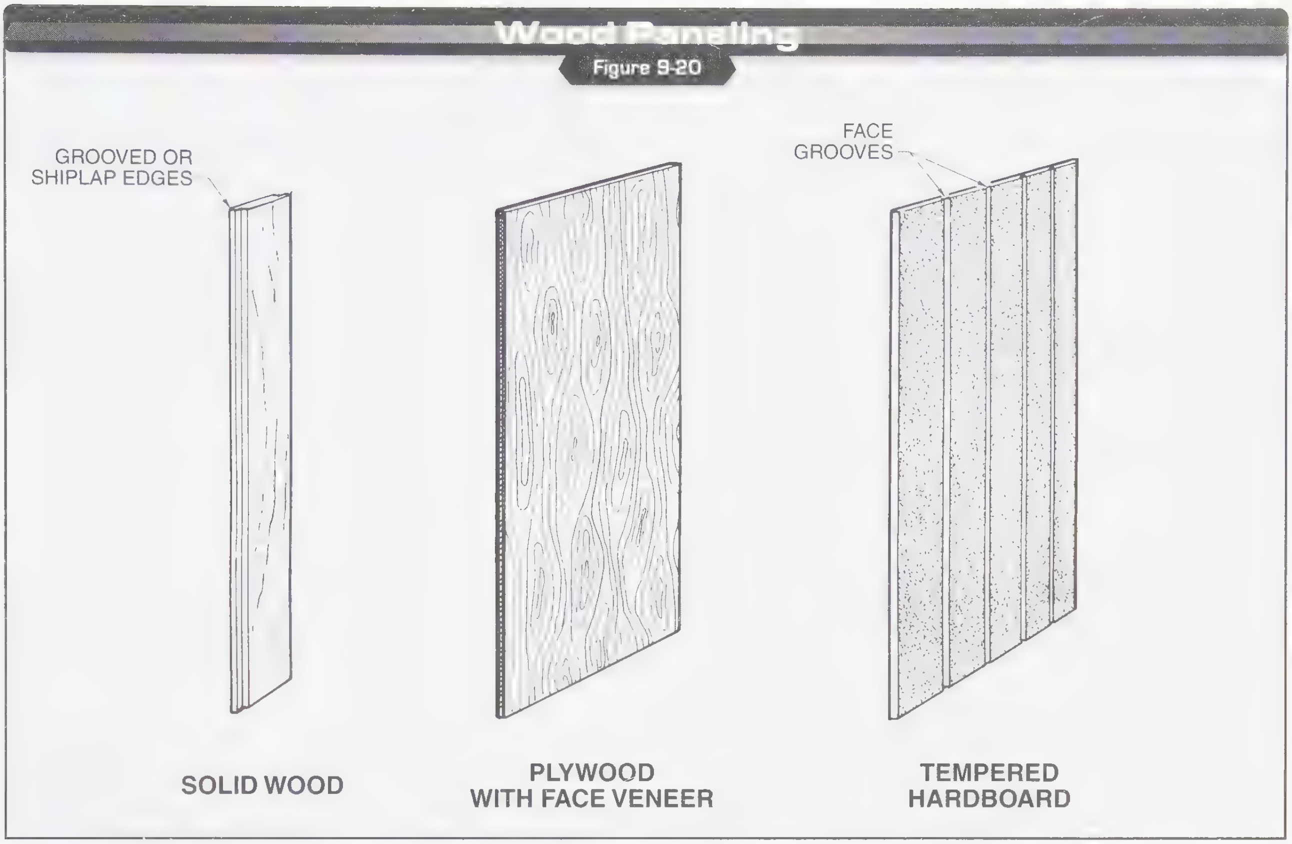


Figure 9-20. *Various types of wood paneling are applied as unfinished or prefinished pieces and panels.*

Figure 9-21. *Ceramic wall tile is fastened to gypsum board using an adhesive. Joints between the tile are filled with grout.*

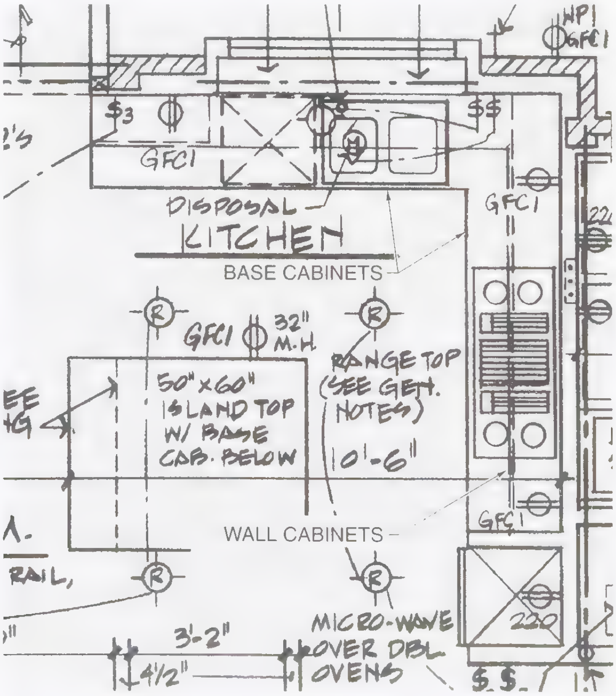


Figure 9-22. *Base cabinets are shown with object lines on floor plans. Wall cabinets are shown with hidden lines since the cabinets are installed above the cutting plane.*

Base cabinets are commonly 24″ deep and 36″ high. The 36″ height includes the thickness of the countertop. Wall cabinets are 12″ deep and 18″ to 30″ high, or 42″ high if the cabinets extend to the ceiling. Base and wall cabinets vary in width, depending on the kitchen layout. Locations for sinks, stoves, cooktops, dishwashers, microwave ovens, and other appliances installed as part of the cabinetry are also indicated. The architect or cabinet manufacturer may provide a separate floor plan showing the cabinet layout and sizes.

Vanities and other bathroom cabinets are shown on floor plans. Vanity cabinets are commonly 20″ deep and 30″ high with varying widths. Medicine cabinets (MC) and mirrors installed in bathrooms are also shown on floor plans.

Closets. The number of shelves for each closet is shown on a floor plan, along with notations regarding the installation of closet rods for hanging clothes. See Figure 9-23. Residential closet shelves are made of particleboard, vinyl-coated wire frames, or metal. Shelf installation height may be noted on details or left to the discretion of the builder. For two-shelf closets, standard shelf heights are 60″ from the floor to the top of the bottom shelf and 72″ for the top shelf. For five-shelf closets installed in pantries and linen closets, the standard shelf heights are 14″ above the floor for the bottom shelf, with each successive shelf 12″ higher.

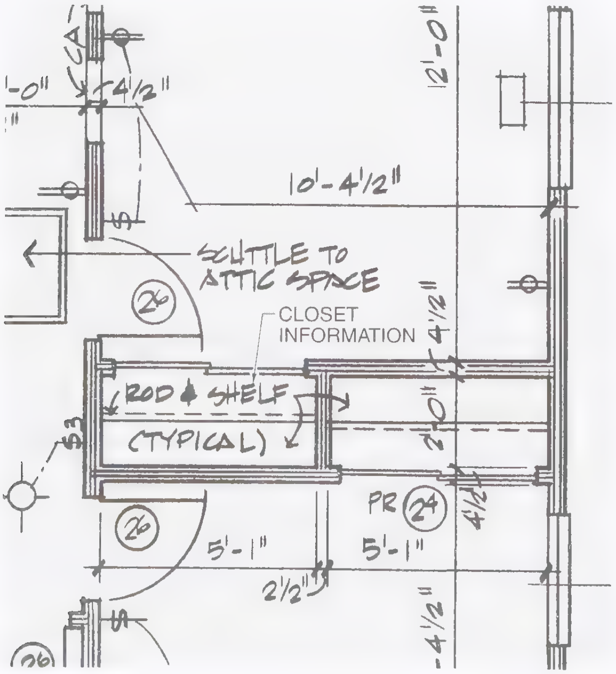


Figure 9-23. Closet shelves shown on floor plans are installed at standard heights unless otherwise indicated by the architect.

UTILITY INFORMATION

Electrical service, telephone lines, plumbing pipes, heating and air conditioning ducts, cable television wires, television cable or satellite connections, computer connections, and other low-voltage wiring are installed above ceilings, under floors, and inside walls and partitions. The locations of floor and wall framing members are laid out to provide adequate openings for utility services. For slab-on-grade floors, wall locations on a floor plan provide installation dimensions for utility services before concrete is placed.

Electrical

Floor plans show wiring and fixture information for electrical service including main service panelboards, wiring, receptacles, switches, and luminaires (lighting fixtures). See Figure 9-24. For large and custom houses, a separate electrical plan may be provided by the architect or the electrical contractor for the layout of various circuits.

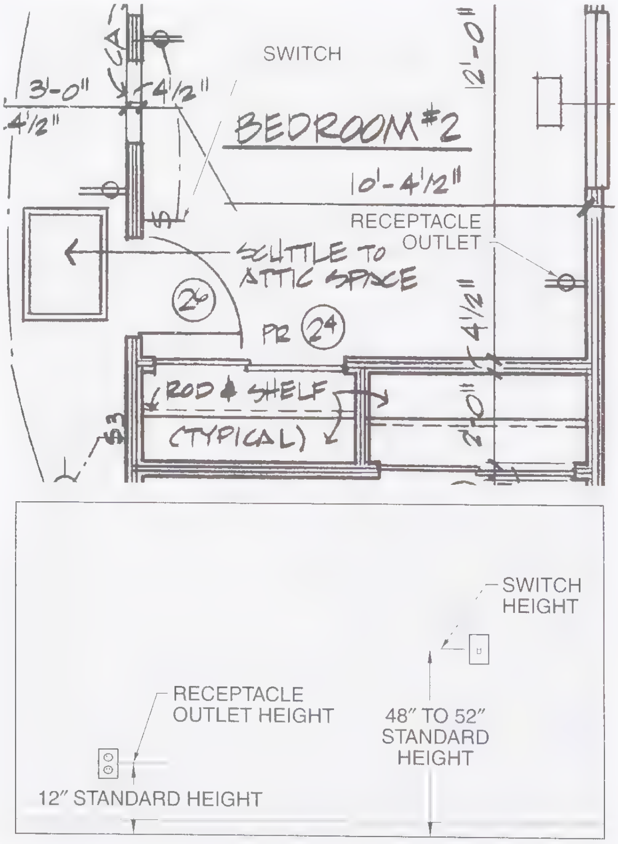


Figure 9-24. Floor plans provide electrical information with a variety of lines and symbols. Unless otherwise indicated, receptacles and switches are installed at standard heights.

Panelboards. The main panelboard in a single-family dwelling is fed from the electrical service. The electrical service enters the house as a lateral (underground) service or as an overhead service. Lateral services are popular because the service entrance cables are protected from the elements and there are no overhead wires to interfere with the exterior view. Each of these services is connected directly to the electrical power company meter, and from the meter to the main panelboard. If necessary, distribution panelboards are fed from the main service panelboard.

Main service panelboards are wall-mounted, commonly in a basement or utility room. Main service panelboards must be accessible to the occupants and located within reach.

Electrical panelboards have a main disconnecting switch that is used to disconnect power to the house. Individual circuits are protected with circuit breakers or fuses. Panelboards are shown on the floor plan as a solid rectangle (distribution panelboard) or as a rectangle with angled, parallel lines (service panelboard).

Wiring. All electrical equipment and wiring shown on prints must conform to the National Electrical Code® (NEC®). Electrical wiring configurations are indicated on floor plans with hidden lines. Hidden lines indicate the wiring necessary to properly and safely connect switches, receptacles, and luminaires. Arrows at the ends of these lines indicate the return to the main service panelboard.

Electrical conductor (wire) size is expressed as gauge (ga). Each gauge of conductor diameter has a number. Lower gauge numbers indicate thicker conductors. For example, a 12 ga conductor is larger in diameter than a 14 ga conductor. The number of conductors in an electrical cable is noted after the wire gauge. For example, a 12-3 cable contains three 12 ga conductors. Conductor size and usage are specified in the NEC®.

Electrical conduit must be installed for routing conductors in slab-on-grade concrete floors and per certain local building codes for electrical conductors in walls. Conduit is installed before concrete is placed for a slab-on-grade floor and before wall finishes are installed. Conduit is made of galvanized steel tubing of various diameters. Conduit is installed as required to provide for electrical wiring at the locations shown on the floor plan. Electrical wiring is also installed through wall studs and ceiling joists.

Nonmetallic sheathed cable (known in the field as Romex) is used for economical wiring of single-family dwellings where permitted by local building codes. Romex has two, three, or four conductors with a green insulated or bare conductor used for grounding equipment. An outer nonmetallic jacket protects the conductors.

In wood-framed construction, holes are drilled through studs and joists to allow electrical cables to be routed. Holes are drilled after floor and wall framing are completed and before interior wall finish materials are applied. In metal-framed construction, electrical cables are routed through openings formed in the C-shape studs and joists. For trussed floor framing, electrical cables are installed through the truss webs without the need for additional drilled holes.

Nonmetallic-sheathed cable is fastened to framing members with staples. Clips and various clamps hold metal-armored cable and conduit in place. The NEC® specifies the frequency and locations for attachment of cables and conduit to building members.

Receptacles and Switches. Symbols on floor plans indicate the approximate locations of receptacles and switches. A circle with several lines through the center indicates a receptacle. An uppercase "S" with a line through the center indicates a switch. Two switches that work in conjunction with each other to control a circuit or luminaire are three-way switches. The number "3" appears next to three-way switches.

Exact locations for receptacles and switches are not included on floor plans; the exact locations and spacing are determined in accordance with the local building code. Receptacles are commonly placed at a standard height of 12″ above the floor. The standard height for wall switches is 48″ to 52″.

Electrical wiring must conform to the National Electrical Code® (NEC®).

Luminaires (Lighting Fixtures). Luminaires are mounted on and fastened to octagonal or 4″ square (1900) boxes. The 1900 boxes have more cubic-inch volume than octagonal boxes and allow more conductors to be installed. Wiring for luminaires is shown with hidden lines on the floor plan. Precise dimensions showing locations of fixtures may also be given, or general instructions such as "CENTER FIXTURE ON CEILING" may be noted on the floor plan.

Plumbing

Plumbing fixtures require a fresh water supply and a method for removal of wastewater. Hot and cold water distribution (supply) pipes and waste pipes can be shown on the floor plan or on a separate plumbing plan. See Figure 9-25. An isometric view of the water distribution and waste pipes may be provided for large or custom houses.

The locations of water distribution pipes and waste pipes are taken into consideration during floor framing. Wall and fixture locations shown on floor plans indicate the proper placement of water distribution and waste pipes. Joist or truss spacing is modified as needed to allow the necessary room for plumbing pipes to project through the floor without interference from the structural floor framing members. For a concrete basement or slab-on-grade concrete floor, underground water supply and waste pipes are installed before concrete is placed.

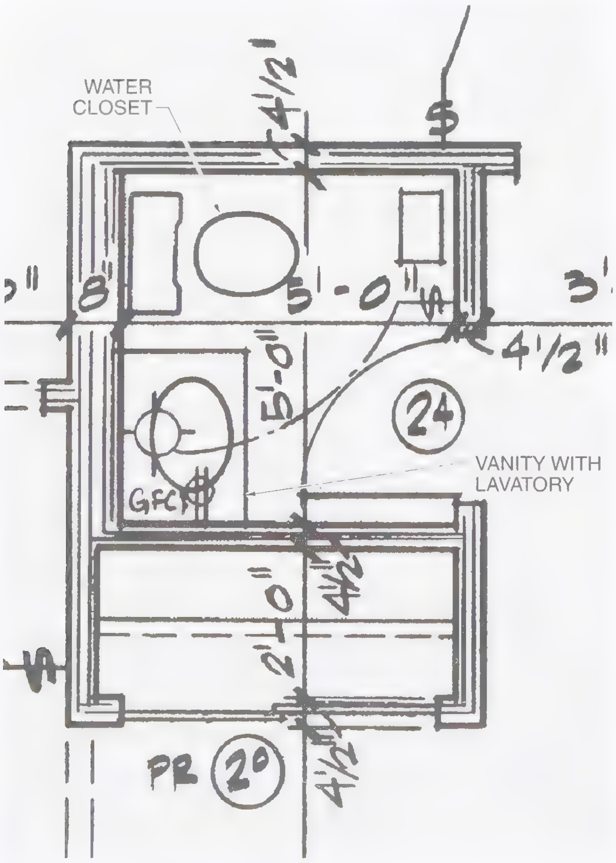


Figure 9-25. Exact locations for plumbing pipes and fixtures are determined by the plumber based on the fixture locations shown on the floor plans.

Distribution Pipes. Hot and cold water distribution pipes are copper or plastic. Plastic water distribution pipe materials include polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), and cross-linked polyethylene (PEX). Water distribution pipes throughout a house are usually ½″ ID (inside diameter). The water service, which extends from the water main to the water meter in the house, is usually a larger diameter, such as ¾″ ID. Copper supply pipe and fittings are soldered together. PVC and CPVC pipe and fittings are solvent-welded together. A variety of fittings, including various elbows and couplings, join the lengths of copper, PVC, and CPVC pipe together. PEX pipe and fittings are joined by mechanically expanding the pipe, inserting the fittings, and allowing the pipe to contract around the fitting.

Water distribution pipes are installed before interior wall finish materials are applied. Pipes are fastened to framing members or masonry with metal or plastic straps that prevent movement of the pipes. At the time of installation, water distribution pipes are capped where they project from the floor or wall. The caps remain in place until the finish materials are installed and the house is ready for installation of finish plumbing fixtures.

Cross-linked polyethylene (PEX) was introduced in the United States in the late 1980s. PEX tubing and fittings are available in sizes ranging from ¼″ to 2″ in diameter.

Locations for water distribution pipes are determined by the plumbing fixtures shown on the floor plan and the location of the water supply entering the house. In shower and tub areas, a small triangle projecting from an adjoining wall indicates the location of the water supply for the showerhead.

Waste Pipes. Waste pipes in residential construction are heavy PVC, acrylonitrile-butadiene-styrene (ABS), or copper. Residential waste pipes range from 1″ to 4″ ID. PVC and ABS pipe and fittings are joined using solvent-welding. Copper waste pipes are joined by soldering. Various fittings and elbows are used to construct the

piping system as required by the local building code. U- and P-shaped traps are installed in the waste lines to retain water and create a barrier that prevents sewer gas from entering the living areas of the house. Vents for waste pipes are installed in the walls and project through the roof or walls. Where possible, vents are placed to project through the rear portion of the roof so they will not detract from the appearance of the front of the house. The vents are flashed at the roofline to prevent rainwater from entering the structure.

Building codes may require a water test of the waste piping system before the inspection of the plumbing is approved. For a water test, waste pipes are temporarily capped and filled with water. The head of the water should exceed 10′-0″ above the highest joint. In some cases, a temporary extension pipe is installed to provide for a 10′-0″ head. The waste pipes must hold the water for a specified amount of time without leaks to pass the water test portion of the inspection. Locations for waste pipes are determined by fixture and floor drain locations shown on the floor plan.

Fixtures. Plumbing fixtures are manufactured from ceramic materials, cast iron coated with porcelain, and metal such as stainless steel. Symbols on floor plans show the locations of plumbing fixtures. Sinks and lavatories are shown with circles, ovals, rectangles, or squares, depending on the design of the sink or lavatory. Water closets are shown with a rectangle against the wall and an oval projecting out from the rectangle. Showers and bathtubs are represented with rectangles or squares, depending on their shapes. The standard size for a residential bathtub is 5′-0″ long and 2′-8″ wide. Shower sizes vary.

Moen, Inc.

Plumbing fixtures are manufactured from durable, corrosion-resistant, nonabsorbent materials.

Exterior hose connections, called hose bibbs (HB), are represented on floor plans with a small cross projecting from the face of the wall and an abbreviation. For convenience, the architect should locate a sufficient number of hose bibbs on the exterior walls to allow for easy access to yard areas. A hose thread vacuum breaker is typically installed on a hose bibb to prevent contaminants from back flowing into the municipal water supply system.

Heating/Air Conditioning

Three common types of residential heating systems are forced air, hot water (hydronic), and radiant electric. Residential cooling systems are typically forced air systems. Each type of system has its own method for distributing heated and cooled air throughout a house. All methods are thermostatically controlled. A thermostat is placed on the wall at a central location in the house. Thermostats are shown on floor plans with a "T" at the approximate wall location where the thermostat is to be installed. Changes in temperature cause the thermostat to start and stop the heating and cooling units. Standard thermostat height is 60″.

Some environmentally friendly approaches are also used as alternatives for heating. Solar heating alternatives are divided into two categories—passive and active. In a passive solar heating system, the south-facing wall of the house is designed to allow the sun's rays to directly heat the living space. Masonry walls or large water-filled tubes are heated and radiate this heat into the rest of the house. Fans or blowers may assist in distributing the heat. In active solar heating systems, water or air is heated in a collector and pumped or blown through a storage medium (usually rock). The heat is transferred from the storage medium to the house as required. Where water is heated, it is incorporated in a hot-water heating system.

Another environmentally friendly alternative for heating and cooling is a geothermal system. Geothermal systems utilize the earth's natural temperature to augment heating and cooling systems. Deep shafts are cut into the earth and the natural heating and cooling that takes place deep below the surface of the ground tempers the ambient air similar to the forces that maintain a constant temperature in caves. This air is circulated through the living area and minimizes the additional heating and cooling required.

The term "geothermal" is formed from two parts—"geo" meaning earth and "thermal" referring to heat.

Forced Air. Heated and cooled air provided by a forced air system has two sets of ducts. See Figure 9-26. Supply air ducts from the furnace or air conditioner convey heated or cooled air into living areas. Supply air ducts are commonly placed between floor joists, in ceiling areas, between wall studs, and under slab-on-grade concrete floors. Openings in the supply air ducts allow heated or cooled air to enter the living area. Return air ducts with openings provide air movement for return of the air to the source of heating or cooling. Ducts are sometimes insulated to minimize heating and cooling loss and conserve energy.

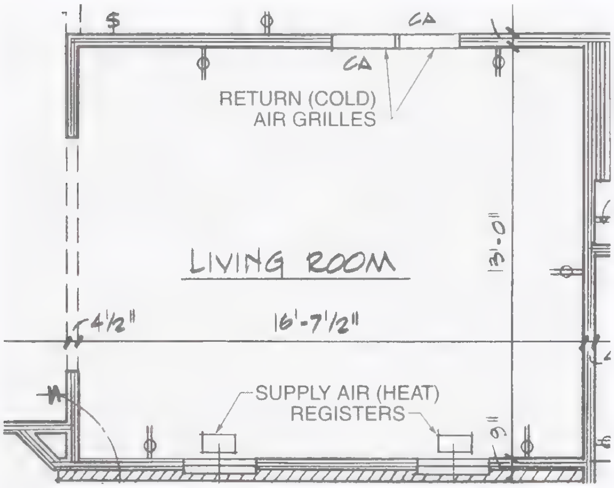


Figure 9-26. Forced-air registers and grilles are indicated with symbols on floor plans.

A fan blower system moves air through the living area and the heating and cooling system. The amount of air movement is expressed in cubic feet of air moved per minute (CFM). The blower size and capacity are determined by the number of air changes that must occur in the living space in a certain period of time and the size of the space to be heated or cooled.

A trunk supply line is installed as near as possible to the center of the house. Supply ducts branch off the trunk line to the outside walls of the house. Openings in supply ducts are placed as close to exterior windows as possible. Return air ducts are placed in the center of the house and channel air back to the blower unit to create an airflow. Supply air and return air duct openings are covered with metal registers and grilles, respectively. Registers have an adjustable damper to regulate airflow at each location.

The architect or heating and air conditioning contractor may provide a separate duct layout for a large house. The sizes of supply and return air vents and their approximate locations are indicated on this plan.

Hot Water. Hot water or steam heating systems regulate the temperature of the living area with hot water or steam pumped through sealed pipes into radiators or convectors. Hot water systems, also known as hydronic systems, are more common than steam systems in new construction. Water in hot water systems is heated by electric, gas, or solar power.

A heating unit (low-pressure boiler) raises the temperature of the water in the piping system to a predetermined temperature. A pump circulates the hot water through the pipes in the system. A central thermostat or a series of individual thermostats at each radiator or convector opens and closes valves that regulate the amount of hot water passing through each radiator or convector. In radiators, the hot water passes through tubes that contact the surrounding air to transfer heat into the living area. Convectors have narrow fins or metal plates attached to the hot water tubing. Heat is transferred from the tubes into these fins to increase the surface contact area of the air with the heating system. An electric fan may also circulate air over the convector fins, making this system more efficient in transferring heat and circulating it through the air in the living spaces.

Hot water pipes may also be installed in a slab-on-grade concrete floor to provide heat to a living area. Pipes are set in place before concrete is placed and radiate heat directly into the concrete floor. Care is taken during concrete placement not to crush, dent, or block the flow of water through the pipes.

Boiler location for a hot water heating system is shown on a foundation plan or floor plan. Pipe sizes and locations may be provided on the floor plan or shown on a separate mechanical plan. Radiator and convector sizes, types, and locations are shown on the floor plan or a mechanical schedule.

Radiant Electric. Radiant electric systems heat thin wires embedded in floors, walls, or ceiling finish materials. Electric current regulated by a thermostat passes through the embedded wires to create heat. This heat is radiated into the living area directly from the surface of floors, walls, and ceilings. The size and spacing of heating wires are shown on electrical plans for this type of heating system.

Radiant heating systems do not directly transfer their heat to the air. Rather, the heat is absorbed by a solid surface, which in turn transfers the heat to the surrounding air.

MATERIAL ESTIMATING

Floor plans provide dimensions needed to calculate the area (in square feet) of livable floor space in a house. Measuring square feet of floor space is a common method for comparing house sizes. The dimensions of the rooms and closets are multiplied by each other to obtain the floor area. For example, a room measuring 24′-6″ × 13′-0″ has 318.5 sq ft of floor area (24.5′ × 13′ = 318.5).

With the calculation of floor space, the amounts of certain construction materials can be estimated from the floor plan. See Figure 9-27. Symbols and architectural notations indicate the construction materials required for construction of the exterior walls and interior partitions, including rough framing materials, masonry, utility services, and finish materials. Waste allowances are added to each type of material to allow for job site waste.

Items such as doors and windows, shelves, electrical and plumbing fixtures, and cabinetry are estimated by counting the number of these items shown on the floor plan or schedule. When counting the items, it is common practice to make a mark of some type on the floor plan to ensure each item is counted only once.

Doors and Windows

The number of doors and windows of each type are counted on the floor plan. Drawing symbols and architectural notations describe each opening. If a door and window schedule is provided, the totals and types of doors and windows may be included.

Elevations are cross-referenced with floor plans during material quantity estimation to verify the proper types and sizes of doors and windows. For example, the 24′-6″ × 13′-0″ room in Figure 9-27 has two doors and one window. Dimensions and symbols indicate a 3′-0″ wide swinging door, an 8′-0″ wide overhead door, and a double-hung window. Elevations for the room would indicate the types, designs, and heights of the doors and the window sizes.

Framing Members

The number of linear feet of wall plates is calculated from the wall length dimensions on the floor plan. Adding the wall lengths and multiplying by 2 for walls with single top plates or by 3 for walls with double top plates determines the required linear feet of plate material. For example, a rectangular building 24′-6″ × 13′-0″ with no interior partitions has a total of 75 linear feet of wall. If the walls are constructed with double top plates, the total linear feet of plate material is 225′-0″ (75′ × 3 = 225′-0″).

Material amounts for headers over windows and doors are determined by adding the width of each opening, 2″ for the jamb allowance, and 6″ to allow for 3″ of bearing on each end of the header and multiplying the sum by 2 (for double headers). For example, a 3′-0″ wide swinging door has a 3′-2″ opening (with the jamb allowance) plus an additional 6″ for bearing at either side of the opening for a total of 3′-8″ (3′-0″ + 2″ + 6″ + 3′-8″). A 3′-8″ single solid header is needed for this opening. The 3′-8″ length is multiplied by 2 for a double header (3′-8″ × 2 = 7′-4″). An 8′-0″ long header is ordered for a built-up double header. A notation on thé floor plan, elevations, or specifications indicates the thickness and width of header materials to determine whether single or double headers are required.

The method for calculating the number of wall studs depends on the on center stud spacing. The proportional relationship of spacing of studs to each foot determines the multiplier for quantity estimating. For studs spaced 16″ OC, the ratio of wall length to studs is 12⁄16, or 3⁄4. The wall length is multiplied by .75 (3⁄4) to calculate the number of studs required for 16″ OC stud spacing. For 24″ OC stud spacing, the ratio is 12⁄24, or 1⁄2. The wall length is multiplied by .5 (1⁄2) to determine the number of studs required for 24″ OC spacing. For example, with studs spaced 16″ OC for 75′-0″ of walls, 75′-0″ is multiplied by .75 (75′ × .75 = 56.25 studs). For waste allowance, 5% is added by multiplying the number of studs by 1.05 (56.25 × 1.05 = 59.06 studs). This amount is then rounded up to 60 studs. Additional studs may be required for corners or wall openings.

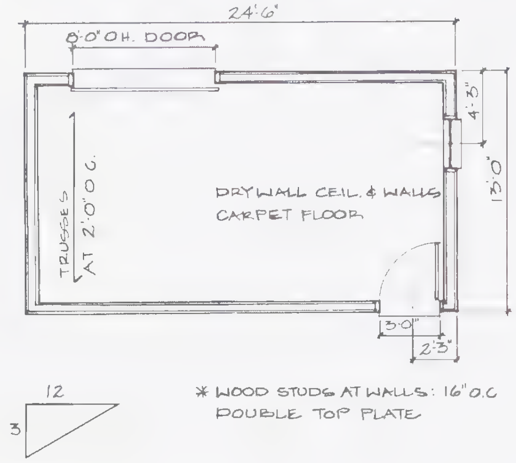
Ceiling joist lengths are determined from the locations of load-bearing walls on the floor plan. The number of ceiling joists required is calculated the same as for wall studs, depending on spacing. The number of roof trusses needed is also calculated based on the on center spacing of the joists or trusses. For example, for a 24′-6″ long house with roof trusses spaced 2′-0″ OC, 24′-6″ is multiplied by .5 (24.5′ × .5 = 12.25 trusses). This number is rounded up to 13 trusses.

Sheathing

Floors are covered with a plywood or oriented strand board subfloor. Plywood, oriented strand board, fiberboard, gypsum board, and expanded foam are the most common exterior wall sheathing materials. Roofs are covered with plywood or oriented strand board roof sheathing. Most sheathing is available in 4′ × 8′ panels, each panel covering 32 sq ft (4′ × 8′ = 32 sq ft).

Estimating Materials

Figure 9-27



FRAMING MEMBERS

Wall Plates

24'-6" × 2 = 49'-0"
13'-0" × 2 = 26'-0"
75'-0" (linear feet)

75'-0" × 3 = **225'-0" wall plates**

Headers

3'-0" — door width
2" — jamb allowance
+ 6" — bearing
3'-8" — solid header
× 2 (doubled)

7'-4" = **8"-0" double header**

Wall Studs (16" OC)

75'-0" linear feet
× .75 stud spacing
56.25
× 1.05 (5% waste)
59.06 = **60 studs**

Roof Trusses (2'-0" OC)

24'-6" length
× .50
12.15 = **13 trusses**

SHEATHING

Subfloor Sheathing

24'-6"
× 13'-0"
318.5 sq ft
× 1.05 (5% waste)
334.425 sq ft

334.425 sq ft ÷ 32 sq ft per sheet =
10.45 = **11 sheets**

Exterior Wall Sheathing

75 linear ft ÷ 4' (each sheet) =
18.75 = **19 sheets**

Roof Sheathing

24'-6"
× 6'-8⅜" (rafter length)
164.15 sq ft
× 2
328.3 sq ft
× 1.05 (5% waste)
344.715 sq ft

344.715 sq ft ÷ 32 sq ft per sheet =
10.77 = **11 sheets**

DOORS AND WINDOWS

1—3'-0" Swinging Door
1—8'-0" Wide Overhead Door
1—Double-Hung Window
(Check elevation or schedule for additional information)

FINISH MATERIALS

Floor Covering (Carpeting)

24'-6"
× 13'-0"
318.5 sq ft
318.5 sq ft ÷ 9 = **36 sq yds**

Gypsum Board (Walls)

75'-0" linear feet
× 8'-0" height
600 sq ft
× 1.08 (8% waste)
648 sq ft

Gypsum Board (Ceiling) (same as subfloor sheathing)

318.5 sq ft
× 1.08 (8% waste)
343.98 sq ft

648 sq ft (wall)
+ 343.98 sq ft (ceiling)
991.98 = 992 sq ft total

992 sq ft ÷ 32 sq ft = **31 gypsum board panels**

Base Molding

24'-6" × 2 = 49'-0"
13'-0" × 2 = 26'-0"
75'-0" linear ft

Figure 9-27. Notations, schedules, and dimensions on the floor plan are used to estimate construction materials.

The overall house dimensions on the floor plan are multiplied to determine the total floor area (in square feet). The total floor area is divided by 32 to estimate the number of subfloor panels. For example, a 24'-6' × 13'-0" rectangular house has 318.5 sq ft of floor space. A 5% waste allowance is added by multiplying the floor

space by 1.05 (318.5 × 1.05 = 334.425 sq ft). This total is divided by 32 to obtain the number of sheets (3324.425 sq ft ÷ 32 = 10.45 panels). This amount is rounded off to eleven 4′ × 8′ sheathing panels needed for the subfloor.

Overall wall dimensions are totaled to determine the linear length. Since wall sheathing panels are typically 4′ wide, the total linear length is divided by 4 to estimate the number of wall sheathing panels. For example, a 24′-6″ × 13′-0″ rectangular house has 75 linear feet of wall length (24′-6″ + 24′-6″ + 13′-0″ + 13′-0″ = 75′-0″). This amount divided by 4 determines the number of 4′-0″ wide wall sheathing panels (75′-0″ ÷ 4 = 18¾ panels). Nineteen wall sheathing panels are ordered for exterior wall sheathing.

For roof sheathing, the length of the house and the length of the roof rafters are multiplied to obtain the roof area. Steeper pitched roofs with longer rafters require more roof sheathing than flatter roofs. The roof area is divided by 32 to determine the number of 4′ × 8′ (32 sq ft) roof sheathing panels. For example, a 24′-6″ × 13′-0″ rectangular house with a gable roof with a 3 on 12 pitch would have 6′-8⅜″ (6.7′) long rafters (before deductions). The house length is multiplied by the rafter length to determine the roof area (24.5′ × 6.7′ = 164.15 sq ft). Next, the roof area is multiplied by 2 to calculate the area of both the front and back roof (164.15 sq ft × 2 = 328.3 sq ft). A 5% waste allowance is added to the roof area (328.3 sq ft × 1.05 = 344.715 sq ft). The total is divided by the coverage area of one sheathing panel to calculate the number of sheathing panels (344.715 ÷ 32 = 10.77). Eleven roof sheathing panels are ordered.

Finish Materials

Floor plans provide dimensions necessary for calculating the amounts of interior finish materials. Architectural notations indicate the type of materials installed. Materials described include floor coverings, wallcoverings (gypsum board, paneling, etc.), and moldings.

Floor Coverings. Floor coverings are estimated by the square yard for carpet and resilient flooring and by the square foot for hardwood and ceramic tile. A square yard is an area measuring 3′-0″ × 3′-0″, or 9 sq ft. A square foot is an area measuring 12″ × 12″, or 144 sq in. In flooring calculations, the number of square feet is divided by 9 to determine the number of square yards.

For example, a carpeted room measuring 24′-6″ wide by 13′-0″ deep has 318.5 sq ft. The square foot area is divided by 9 to determine the number of square yards of carpet required to cover the room (318.5 sq ft ÷ 9 = 35.39 sq yd). Thirty-six square yards of carpet are ordered to cover the floor. Widths and lengths of carpeting pieces vary according to the style and manufacturer and must be taken into consideration when carpet patterns must match in a room.

Gypsum Board. The number of gypsum board panels required for flat ceilings is calculated in the same manner as the subfloor. The total floor area is equal to the ceiling area. A waste allowance of 8% is added to the area. For slanted (sloped or cathedral) ceilings, the number of gypsum board panels is calculated using the same method as for roof sheathing. Rafter length is multiplied by the room length to determine the number of gypsum board panels for a slanted ceiling.

The number of gypsum board panels´required for wall finish is calculated by adding the linear feet of wall length and multiplying by the wall height. For example, a 24′-6″ × 13′-0″ room has 75′-0″ of linear wall length (24′-6′ + 24′-6″ + 13′-0″ + 13′-0″ = 75′-0″). The linear wall length is multiplied by the wall height to calculate wall area. If the room in the example has 8′-0″ high walls, the wall area is 600 sq ft (75′ × 8′-0″ = 600 sq ft). A waste allowance of 8% is then added to determine the total area (600 sq ft × 1.08 = 648 sq ft).

The drywall for the ceiling is calculated the same as subfloor panels. The example room contains 318.5 sq ft (24.5′ × 13′ = 318.5 sq ft). An 8% waste allowance is added to determine the total area (318.5 sq ft × 1.08 = 343.98 sq ft; rounded to 344 sq ft). When added together, the total area required to be covered by gypsum board is 922 sq ft (648 sq ft + 344 sq ft = 992 sq ft).

National Wood Flooring Association

The amount of hardwood flooring required for an installation is estimated by the square foot.

The coverage area for a sheet of gypsum board depends on the lengths of the panels to be installed. Gypsum board panel lengths are matched to room sizes to avoid waste and an excessive number of joints between sheets. The total room area is divided by the area of a gypsum board panel. If 4′-0″ × 8′-0″ (32 sq ft) panels are used in the example room, 31 panels will be required (992 sq ft ÷ 32 = 31 panels).

Paneling. The number of sheets of wood paneling is calculated in the same manner as exterior wall sheathing. When 4′ wide sheets are to be installed, the linear wall length is divided by 4 to determine the required number of sheets of paneling.

Molding. The amounts of finish molding, such as baseboard, casing, chair rail, and crown molding, are estimated by the linear foot. The total linear feet of these moldings is determined from wall length dimensions on the floor plan.

For example, a 24′-6″ × 13′-0″ room has 75′-0″ linear feet of wall length. A minimum of 75′-0″ of baseboard, chair rail, and crown molding is required for the room. A waste allowance should be added to provide for trimming and fitting at the corners. Where special finish moldings are noted, they are estimated individually for length and type.

The amount of casing required depends on the width and height of each opening. For a 3′-0″ wide by 6′-8″ high door, casing is installed on each side (6′-8″ × 2 = 13′-4″). Typically, a 7′-0″ length of casing is required at each side to allow for fitting at each top corner. A 4′-0″ piece of casing would be required across the top of the door opening to allow for fitting (depending on the width of the casing).

ABBREVIATIONS AND SYMBOLS

Abbreviations and symbols shown on floor plans represent construction materials for exterior walls, interior partitions, and interior finish materials. Symbols on floor plans are different from those on elevations for similar materials.

Abbreviations

Abbreviations on floor plans include the names of the rooms, finish materials such as flooring and wallcoverings, and utility fixtures. See Figure 9-28. Some terms, such as "interior," may have more than one abbreviation.

The area (A) of a square wall or ceiling is calculated by squaring the side's length ($A = s^2$).

Symbols

Floor plan symbols show construction materials for exterior walls and interior partitions. See Figure 9-29. Door and window types are described with various symbols. Door and window symbols show the swing direction. Electrical switches, receptacles, and luminaires are shown with symbols that indicate the type of switch and the approximate location. Electrical wiring and circuit configurations may be shown with symbols. Plumbing fixtures such as water closets, showers, bathtubs, and hose bibbs are shown with symbols. Information about plumbing piping for both water supply and wastewater are also shown with symbols on floor plans. Symbols for heating and air conditioning indicate general locations for supply air registers and return air grilles for forced air systems. Radiant pipes or wires are also shown with floor plan symbols.

OTHER REFERENCES

The foundation plan, elevations, specifications, and details provide additional information about the construction materials and interior finish materials that appear on the floor plan. Cross-referencing the other prints provides an overall picture of materials and dimensions. For example, the floor plan provides the information about the number of risers in a stairway, and the overall floor-to-floor height is obtained from either the elevations or details.

Specifications

The types of construction materials for wall construction and finish are indicated in the specifications. Methods for application of interior finish materials, colors, and manufacturers' product numbers are noted in the specifications. Types of electrical and plumbing fixtures installed are also given.

Sections and Details

Typical wall section and other details show the wall construction components and interior finish materials. Cabinetry, special moldings, and closet shelves for special conditions can also be shown on details.

FLOOR PLAN ABBREVIATIONS			
Abbreviation	**Term**	**Abbreviation**	**Term**
ACS	Access	LINO or LINOL	Linoleum
ACSP or AP	Access panel	LKT	Lookout
ADD or ADH	Adhesive	LNG	Lining
AT.	Asphalt tile	LR	Living room
B	Bathroom	MC	Medicine cabinet
BC	Between centers	OP	Operator
BCL	Broom closet	OVHD DR	Overhead door
BLK	Block	P	Porch
BLKG	Blocking	PAN.	Pantry
BPL or BRG PL	Bearing plate	PASS.	Passage
BR	Bedroom	PFN	Prefinished
BT	Bathtub	PL	Plate
BYP	Bypass	PLAT	Platform
CA	Cold air	PORC	Porcelain
CFM	Cubic feet per minute	PREFAB or PFB	Prefabricated
CLG	Cooling or Ceiling	PTN	Partition
CLO	Closet	PW	Projected window
CNCL	Concealed	QT	Quarry tile
CT	Ceramic tile	R	Riser
CW	Cold water	R or RM	Room
DBL ACT. or DA	Double-acting	R or RNG	Range
DD	Dutch door	RAD	Radiator
DK	Deck	RBT or R TILE	Rubber tile
DMR	Dimmer	REC	Recessed
DNG R or DR	Dining room	REF or REFR	Refrigerator
DW	Dishwasher	REG	Register
EMT	Electric metallic tubing	RGH	Rough
ENTR	Entrance	RO	Rough opening
EQPT	Equipment	S	Scuttle
EXT	Extinguisher	SC	Sillcock
FC	Furred ceiling	SC	Solid core
FL	Flush	SCH or SCHED	Schedule
FLMT	Flush mount	SD or SL DR	Sliding door
FLR or FLG	Flooring	SH	Shower
FLUR or FLUOR	Fluorescent	SH & RD	Shelf and rod
FUR.	Furring	SHELV	Shelving
GB	Gypsum board	SK or S	Sink
GFCI	Ground-fault circuit interrupter	SP	Standpipe
GRB	Garbage	ST	Stairs
GYP	Gypsum	STOR	Storage
HA	Hot air	STWY	Stairway
HC	Hollow core	SUSP	Suspend
HD	Head	TBG	Tubing
HDR	Header	THERMO or T	Thermostat
HTD	Heated	TR or T	Tread
HVAC	Heating, ventilating, and air conditioning	U RM	Utility room
HW	Hot water	V	Vent
INTR or INT	Interior	V TILE or VT	Vinyl tile
K or KIT	Kitchen	VENT	Ventilation
KD	Knocked down	VS	Vapor seal
LAU	Laundry	VT	Vaportight
LAV	Lavatory	WA	Warm air
LCL or LCLO	Linen closet	WC	Water closet
LDG	Landing	WV	Wall vent
LIB	Library		

Figure 9-28. Abbreviations on floor plans describe finish materials, fixtures, and utilities.

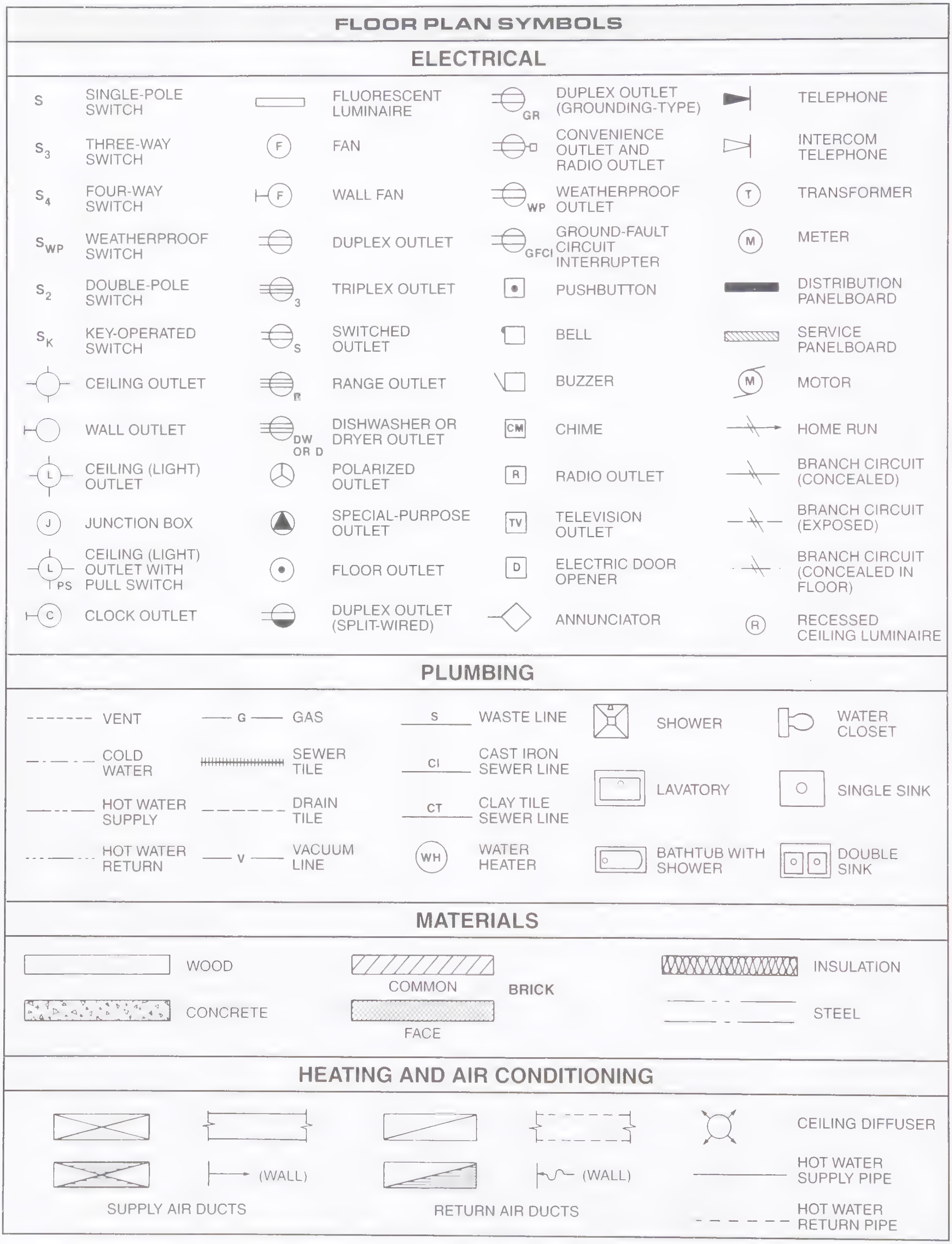


Figure 9-29. *Construction materials, electrical information, plumbing fixtures and pipes, and heating and air conditioning vents are shown on floor plans using symbols.*

REVIEW QUESTIONS

9

Floor Plans

Name ______________________________ Date ______________

True-False

T F 1. Interior partitions and exterior walls are shown with hidden lines on floor plans.

T F 2. The overall dimensions of a house on a floor plan are typically placed along the dimension lines farthest from the house.

T F 3. Exterior door locations are shown with centerlines.

T F 4. The hinges for a double-acting door are recessed in the floor or mounted to the bottom of the door.

T F 5. Pocket sliding doors are typically installed for garage door openings.

T F 6. A bifold door is made of two small doors hinged together.

T F 7. Window centerlines and dimension lines are usually the closest dimension lines to the outside of the house.

T F 8. Masonry walls require no additional structural provisions at the sides of openings.

T F 9. Coded floor plans for wall placement are used for prefabricated walls.

T F 10. Underlayment is installed after the installation of resilient flooring.

T F 11. Interior load-bearing partitions are typically not required for houses with roof trusses.

T F 12. Interior finish material information is not included on a floor plan.

T F 13. In stairway openings, the arrow always indicates the downward direction of travel.

T F 14. Gypsum board should not be installed as a backing material for other wall finish materials.

T F 15. Plywood with a finish face veneer is used for interior paneling.

T F 16. Base and wall cabinets are shown with object lines on floor plans.

T F 17. Dimension lines indicate receptacle locations on floor plans.

T F 18. Traps are U-shape plumbing fittings installed in waste lines.

T F **19.** A thermostat is installed close to an exterior wall.

T F **20.** Sizes of heating and cooling registers and grilles may appear on floor plans or separate ductwork drawings.

T F **21.** Return air ducts are essential to a radiant heating system.

Multiple Choice

______ **1.** The common drawing scale for a floor plan is ___.
- A. ⅛″ = 1′-0″
- B. ¼″ = 1′-0″
- C. ½″ = 1′-0″
- D. 1″ = 10′-0″

______ **2.** For a two-story house, the floor framing information shown on the first floor applies to the flooring for the ___.
- A. first floor
- B. second floor
- C. basement
- D. none of the above

______ **3.** All interior door opening locations are dimensioned to the ___.
- A. center
- B. face of the door
- C. schedule reference code
- D. none of the above

______ **4.** Bypass doors overlap ___ of the opening.
- A. at the top
- B. at the bottom
- C. in the middle
- D. at each side

______ **5.** A cased or finished opening is indicated on a floor plan with ___.
- A. object lines
- B. centerlines
- C. hidden lines
- D. wavy lines

______ **6.** Flooring information on floor plans includes ___.
- A. framing material sizes
- B. spacing of framing members
- C. direction of framing installation
- D. all of the above

______ **7.** The number along the arrow in stairway openings indicates the ___.
- A. number of treads
- B. number of risers
- C. amount of headroom
- D. number of stringers

______ 8. The arrow for roof framing information ___.

A. is parallel with the roof framing members
B. indicates the size of the roof components
C. indicates the spacing of roof framing members
D. all of the above

______ 9. Electrical circuits are shown on floor plans with ___.

A. hidden lines
B. object lines
C. centerlines
D. dimension lines

______ 10. Air movement for heating purposes is measured in ___.

A. square feet per hour
B linear feet per second
C. cubic feet per minute
D. square feet per minute

Identification

______ 1. Pocket sliding door

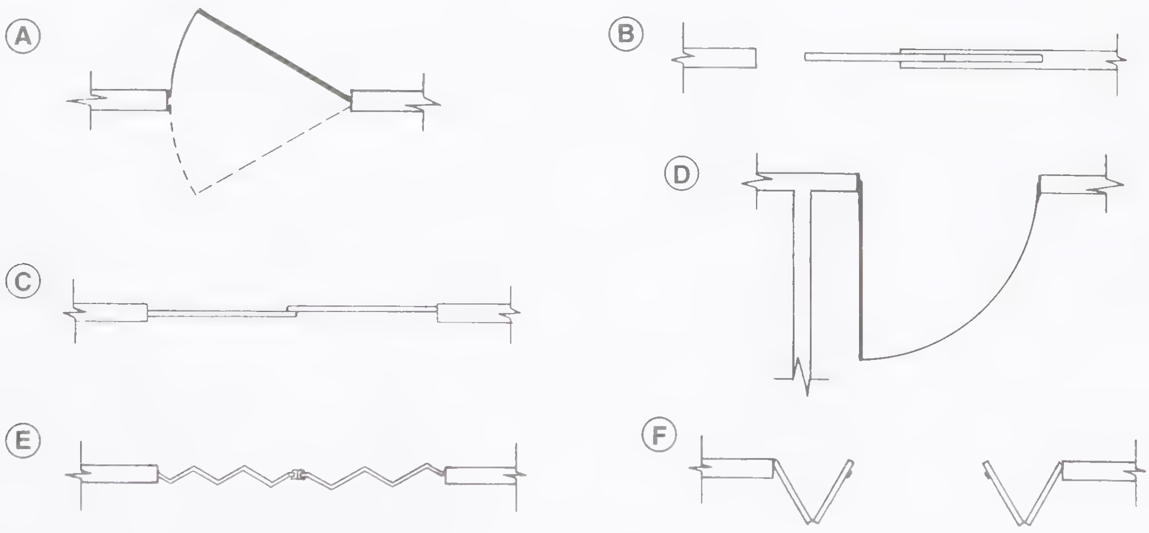
______ 2. Swinging door

______ 3. Double-acting door

______ 4. Bifold door

______ 5. Multifolding door

______ 6. Bypass door



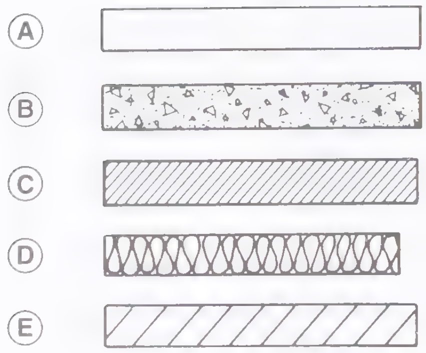
______ 7. Insulation

______ 8. Wood

______ 9. Common brick

______ 10. Face brick

______ 11. Concrete



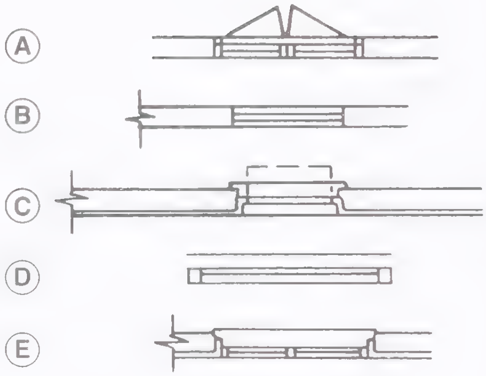
______ 12. Awning window

______ 13. Fixed-glass window

______ 14. Horizontal sliding window

______ 15. Casement window

______ 16. Double-hung window



______ 17. Water closet

______ 18. Ceiling (light) outlet

______ 19. Special-purpose outlet

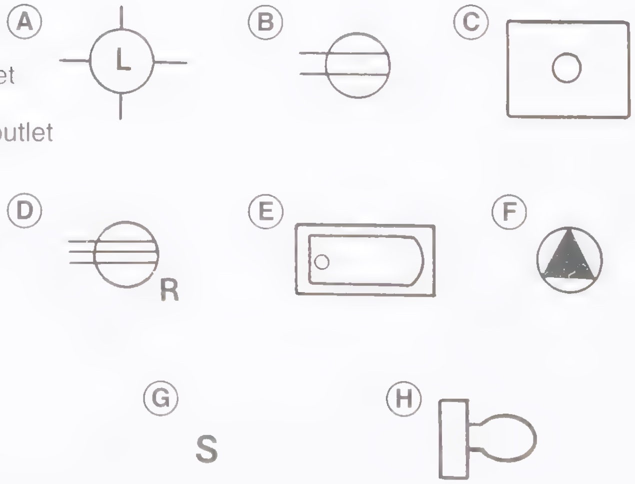
______ 20. Sink

______ 21. Duplex receptacle

______ 22. Bathtub

______ 23. Range outlet

______ 24. Switch



Completion

_______________ 1. Exterior walls are constructed to be thicker than interior partitions to provide additional room for ___.

_______________ 2. Code letters and numbers at floor plan openings are cross-referenced to a(n) ___.

_______________ 3. A 32″ wide door is dimensioned on a floor plan as a(n) ___ door.

_______________ 4. ___ doors are commonly used as exterior sliding glass doors.

_______________ 5. Exterior wall studs are typically spaced ___″ OC.

_______________ 6. For interior partitions, a(n) ___ partition supports floor joists for upper floors.

_______________ 7. The most common manufacturing method for residential carpet is ___.

_______________ 8. The two most common types of wood finish flooring are ___ and ___.

_______________ 9. Ceramic tile is manufactured in blocks of 1″ square tiles that are attached to a(n) ___ backing.

_______________ 10. Linen closets and pantries typically have ___ shelves.

_______________ 11. Two 12 ga conductors encased in one cable is described as a(n) ___ size cable.

_______________ 12. Two materials used for plumbing supply piping are ___ and ___.

_______________ 13. Plumbing fixtures are represented on floor plans with ___.

_______________ 14. Two common residential heating systems are ___ and ___.

Abbreviations

Provide the abbreviations for the following terms.

_______________ 1. Bathroom

_______________ 2. Bedroom

_______________ 3. Ceiling or Cooling

_______________ 4. Cubic feet per minute

_______________ 5. Gypsum board

_______________ 6. Flooring

_______________ 7. Gypsum

_______________ 8. Heating, ventilating, and air conditioning

_______________ 9. Living room

Printreading

Refer to the floor plan on page 219 for questions 1 through 21.

T F **1.** The dining room light is on a three-way switch.

T F **2.** The dining room walls are finished with paneling.

T F **3.** The kitchen ceiling lights are recessed.

T F **4.** The kitchen floor is covered with carpet.

T F **5.** There are three 220 V outlets in the kitchen.

T F **6.** The door leading to the basement stairway is 28″ wide.

T F **7.** The interior partitions are 4½″ thick.

T F **8.** All three rooms shown have finish molding at the intersection of the ceiling and walls.

________ **9.** The abbreviation "DA" on the dining room door indicates ___.
- A. dimmer-activated
- B. double-acting
- C. double-approach
- D. dining area

________ **10.** The exterior walls at the front of the dining room are ___.
- A. brick on concrete masonry units
- B. brick veneer and wood framing
- C. siding and wood framing
- D. solid brick

________ **11.** The stool in the rear kitchen window is ___.
- A. 10″ deep
- B. waterproof
- C. covered with plastic laminate
- D. centered on the kitchen sink location

________ **12.** The luminaire in the desk area is ___ long.

________ **13.** The dining room floor is covered with ___.

________ **14.** There are ___ receptacles in the dining room.

________ **15.** The interior dimensions of the dining room are ___.

________ **16.** Allowing for a 1″ overhang, the dimensions of the island cabinet in the kitchen are ___.

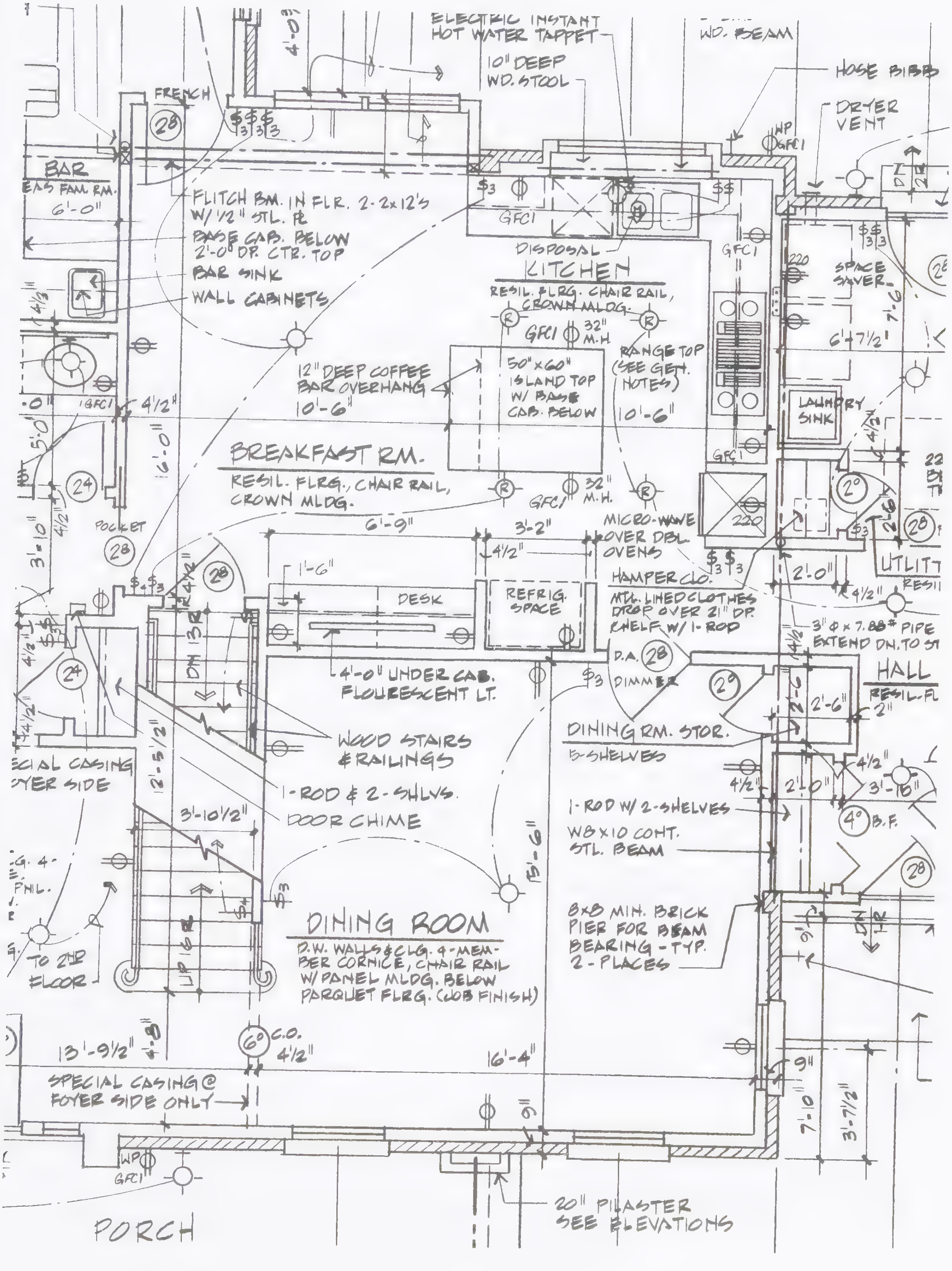
________ **17.** The exterior receptacle behind the kitchen is noted as ___.

________ **18.** ___ risers are installed in the stairway extending down from the breakfast room to the basement.

________ **19.** The front exterior walls are ___″ thick.

________ **20.** The refrigerator space is ___ wide.

________ **21.** The light in the breakfast room is controlled by ___ switches.


ELECTRIC INSTANT HOT WATER TAPPET
WD. BEAM
10" DEEP WD. STOOL
HOSE BIBB
DRYER VENT
FRENCH
BAR
FLITCH BM. IN FLR. 2-2x12's W/ 1/2" STL. PL
BASE CAB. BELOW 2'-0" DP. CTR. TOP
BAR SINK
WALL CABINETS
DISPOSAL
KITCHEN
RESIL. FLRG. CHAIR RAIL, CROWN MLDG.
SPACE SAVER
12" DEEP COFFEE BAR OVERHANG
50"x60" ISLAND TOP W/ BASE CAB. BELOW
RANGE TOP (SEE GEN. NOTES)
LAUNDRY SINK
BREAKFAST RM.
RESIL. FLRG., CHAIR RAIL, CROWN MLDG.
MICRO-WAVE OVER DBL. OVENS
POCKET
DESK
REFRIG. SPACE
HAMPER CLO.
MTL. LINED CLOTHES DROP OVER 21" DP. SHELF W/ 1-ROD
3" ⌀ x 7.88# PIPE EXTEND DN. TO ST
UTILITY
HALL
4'-0" UNDER CAB. FLOURESCENT LT.
DIMMER
DINING RM. STOR.
5-SHELVES
WOOD STAIRS & RAILINGS
SPECIAL CASING FOYER SIDE
1-ROD & 2-SHLVS.
DOOR CHIME
1-ROD W/ 2-SHELVES
W8x10 CONT. STL. BEAM
8x8 MIN. BRICK PIER FOR BEAM BEARING - TYP. 2-PLACES
DINING ROOM
D.W. WALLS & CLG. 4-MEMBER CORNICE, CHAIR RAIL W/ PANEL MLDG. BELOW PARQUET FLRG. (JOB FINISH)
TO 2ND FLOOR
UP
DN
C.O.
SPECIAL CASING @ FOYER SIDE ONLY
20" PILASTER SEE ELEVATIONS
PORCH
GFCI
WP GFCI
13'-9 1/2"
16'-4"
6'-9"
3'-2"
3'-10 1/2"
12'-5 1/2"

Math

Using the floor plan shown, determine the amounts of materials listed below. (Note: Round all answers to the next highest number.)

____________________ **1.** Total floor space (in sq ft)

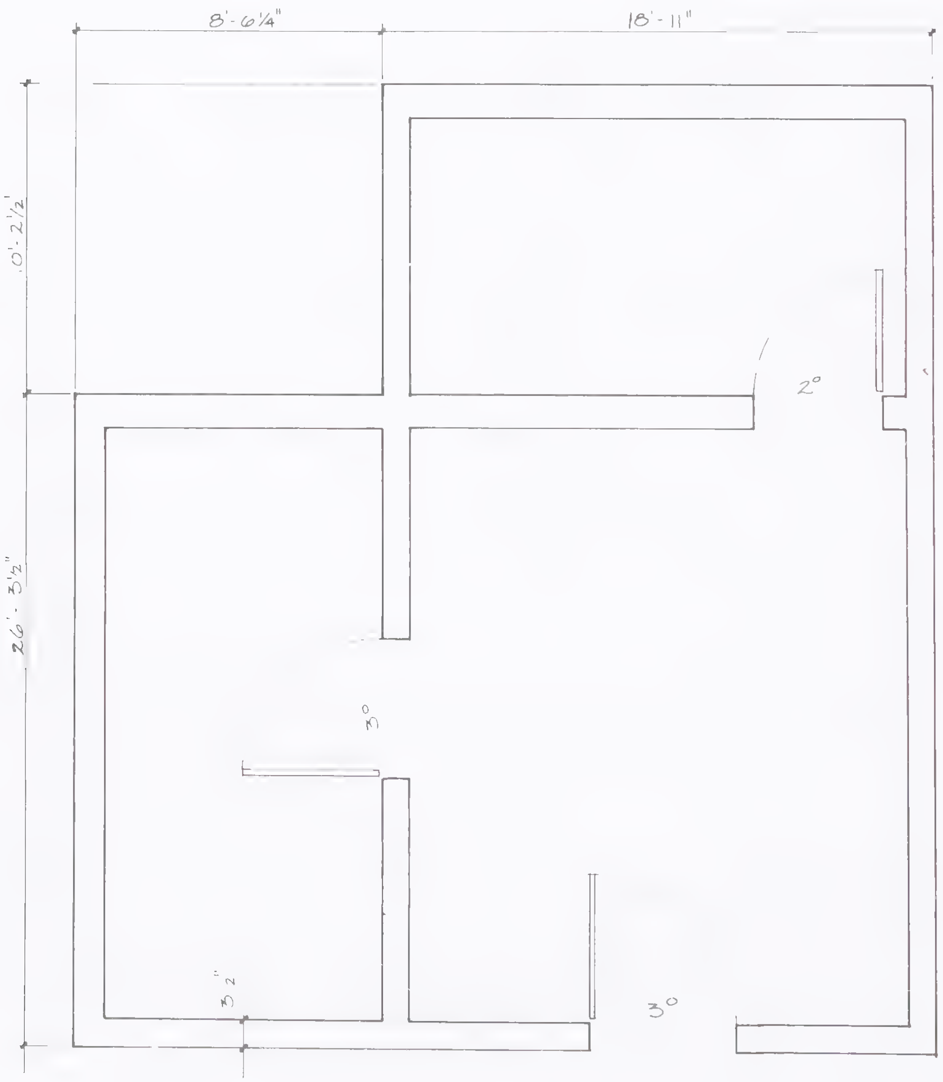
____________________ **2.** Linear feet of wall plates (all double top plate)

____________________ **3.** Number of wood studs (16″ OC)

____________________ **4.** Wall area only (8′ high; no door deductions)

____________________ **5.** Cubic yards of concrete (6″ thick floor slab)

____________________ **6.** Linear feet of interior base molding



Chapter 10 Sections and Details

Sections are created by making an imaginary slice through an object at a given point or along a given plane. Sections are used to show the interior features of a wall or construction component.

Details show construction features of a house at a larger scale than foundation plans, elevations, floor plans, and sections. The construction features range from the reinforcement for the foundation to the design for custom interior moldings. While most drawings in a set of residential prints are drawn at a ¼″ = 1′-0″ scale, details are drawn at a larger size as needed.

Sections and details are not isolated on a separate sheet of the prints. Rather, sections and details are shown on the same sheets as other drawings. Sections and details are typically smaller in size than foundation plans, floor plans, and elevations. If possible, an architect tries to place details on the part of the print to which they are most applicable. For example, a reinforcement detail for the foundation is commonly placed on the same sheet as the foundation plan. However, this practice may not always be possible due to space restrictions.

SECTIONS

Sections are taken through a building component or area that requires additional description. See Figure 10-1. A cutting plane indicates the location of each section on foundation plans, elevations, or floor plans. A cutting plane is a bold line composed of long and short dashes with another short line perpendicular at each end. The short line has an arrow that indicates the direction of sight shown on the section. Letters or numbers placed by the arrows are used as a reference for the section.

Other sections—referred to as typical sections—show common construction conditions that occur throughout the building. For example, a typical wall section shows the wall construction for the entire house except for areas noted differently. Materials and dimensions are noted on sections. Sections also show typical foundation and wall construction. These sections, typically shown as details, may not have a letter or number code but are given a title that describes the location of the section.

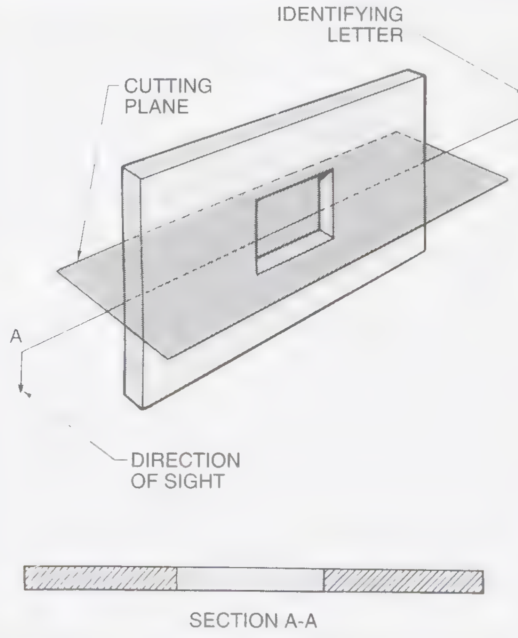


Figure 10-1. Sections provide information regarding the interior features of an object or area.

Foundation Sections

Dimensions, reinforcement information, and foundation materials are shown on sections and details. See Figure 10-2. Separate sections or details or a typical wall section may be used to provide this information. Additional information about retaining walls, and porch, deck, and column foundations is also provided on foundation sections.

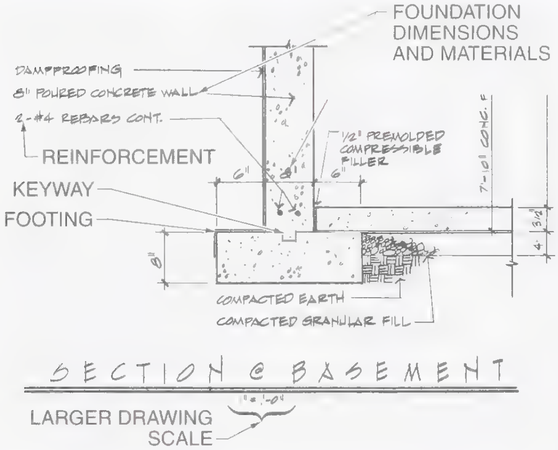


Figure 10-2. Foundation sections and details describe materials, reinforcement, and dimensions for foundation footings and walls.

Foundation Footing/Wall Sizes. The depths and widths of foundation footings and walls are shown with extension and dimension lines on sections and details. Dimensions are expressed in feet, inches, and fractions of an inch. On foundation sections, footings are shown with object lines rather than with the hidden lines that appear on foundation plans. Dimensions for columns and pilasters also appear on sections and details. For houses with basements, the thickness of the concrete basement floor slab and the materials for the area below the slab are also shown on foundation sections.

Reinforcement. Sizes and spacing for steel reinforcement are shown on sections or details. Rebar is the most common form of reinforcement for concrete foundation footings and walls. Rebar sizes are indicated by number, with the number representing the diameter of the rebar in eighths of an inch. For example, a #3 rebar is 3/8" diameter.

Slabs-on-grade are reinforced with welded wire reinforcement (WWR). The spacing of the wires, wire shape, and wire size are noted in the architectural notations. For example, a 6 × 6—W2.0 × W2.0 indicates a wire spacing of 6" in both directions, with smooth wire (W), and a .02 sq in. cross-sectional area.

Masonry foundations require different reinforcement. Long steel webs, known as ladder ties or truss ties, are installed in the mortar joints for horizontal reinforcement. The type and size of ladder and truss ties are noted on sections or details.

The size and spacing of foundation anchor bolts may also be noted on sections or details. The size and spacing may also be noted in the specifications.

Materials. Weatherproof and decay-proof foundation construction materials, such as concrete, pressure-treated wood, and masonry, are noted on sections or details. Additional waterproofing materials, such as a liquid asphalt membrane applied to the exterior of below-grade foundation walls, are noted on sections or details. See Figure 10-3.

The Environmental Protection Agency no longer allows the use of lumber treated with chromated copper arsenate (CCA) for residential construction.

WATCHDOG WATERPROOFING®

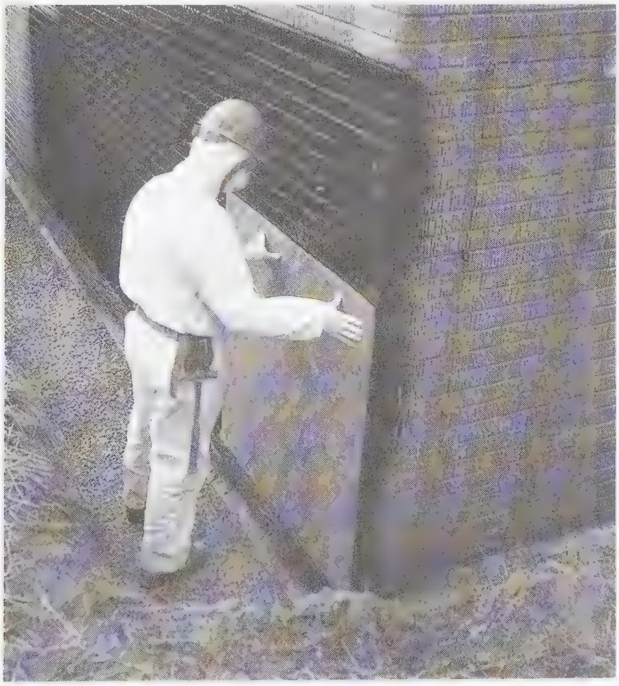
Figure 10-3. Materials applied to the outside of foundation walls to improve water resistance, such as a liquid asphalt membrane, are shown on details.

Plastic drain tile installed around foundation footings are noted on sections or details. Insulation materials used for foundation systems are also shown. Architectural notations are used to describe each material.

Wall Sections

The most common section included in a set of residential prints is a typical wall section. A typical wall section is an imaginary slice taken vertically through an exterior wall to expose the framing members, insulation, exterior and interior finish, and roofing. See Figure 10-4. Types of materials are noted with abbreviations and symbols. Dimensions for the sizes of all components are expressed in feet, inches, and fractions of an inch. Height and thickness dimensions are also provided for foundations, walls, and ceilings.

The foundation footing shown in Figure 10-4 is 10″ thick by 2′-0″ wide. A 2 × 4 continuous keyway is formed in the footing to provide a cold joint with the 10″ thick foundation wall. Two #4 rebar are embedded in the foundation wall. The walls for the two-story house with basement are platform-framed with 2 × 4 studs, single bottom plates, and double top plates. The floors are framed with 2 × 10 floor joists and continuous header joists. Wall sheathing is a ¾″ insulated sheathing. Brick veneer completes the exterior wall.



TUFF-N-DRI

Rigid foundation insulation panels provide a means for groundwater to flow, protect the liquid asphalt membrane under the panels, and provide good insulation capabilities.

Construction Materials/Methods. Wood and masonry are two common structural and finish materials used for residential exterior wall construction. The sizes and spacing of wood framing members for floors, walls, and ceilings are noted on typical wall sections. The types and sizes of masonry units also are shown on typical wall sections.

Insulation sizes, types, and locations in exterior walls are noted on typical wall sections. In Figure 10-4, fiberglass batts are inserted in wood-framed walls between the studs. A 3½″ thick batt provides an insulation value of R-11. Poured vermiculite insulation or other expanded foam materials may be installed in exterior masonry walls.

Exterior Finish. Weatherproof coverings for exterior walls are noted on typical wall sections. For wood- and metal-framed walls, sheathing materials applied to the outside face of the wall studs are noted. Sheathing materials have various insulation and structural qualities. The thickness and type of siding materials are noted. Typical wall sections also describe the types and locations of flashing. For masonry veneer, the type of masonry and the type and spacing of masonry anchors are noted. In Figure 10-4, the 4″ brick-veneer wall is secured to the framed walls using galvanized metal ties spaced 16″ OC vertically and 32″ OC horizontally.

Sections for solid masonry exterior walls show the types and sizes of structural and finish masonry units including concrete masonry units (CMUs), common and face brick, and various types of stone. Wood or metal furring may be attached to the interior face of masonry walls to provide a true surface for fastening finish materials.

Separate sections or details may be provided for soffit construction. The types and sizes of framing and finish materials, trim members, gutters, and soffit vent spacing are noted. Sections or details may also show porch framing and handrail installation information.

Interior Finish. Materials that cover the interior walls are noted on sections or details. These include gypsum board, plaster, wood or composite panels, tile, and masonry materials. A typical wall section notes the thicknesses of wall and ceiling finish materials. Information may also be provided about floor finish materials.

Gypsum board, commonly referred to as drywall, is the most common interior wall and ceiling finish material used in residential construction.

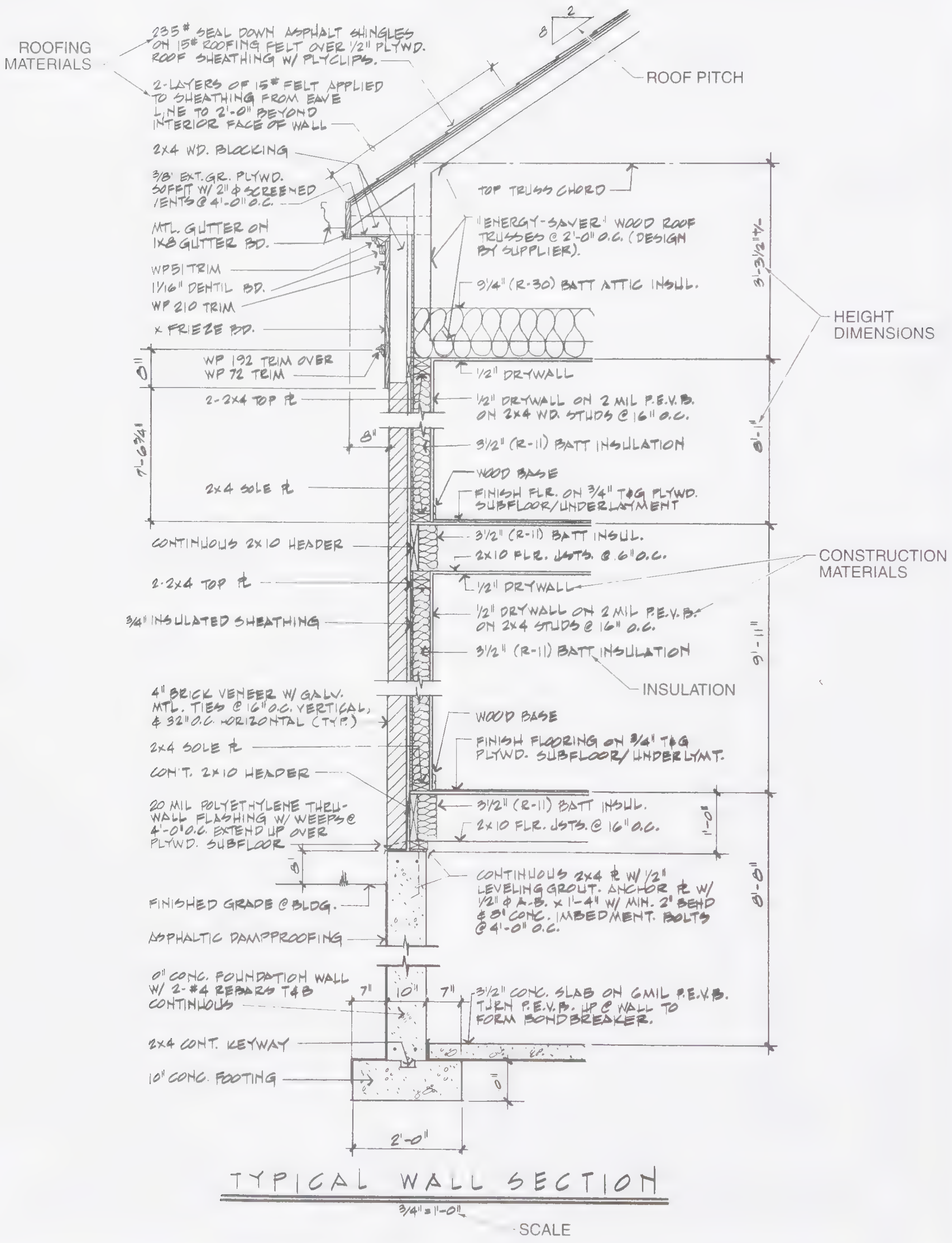


Figure 10-4. Typical wall sections provide information about construction materials and methods.

Roof Information. Ceiling joists, rafters, trusses, insulation, roof sheathing, and roof covering are described on typical wall sections. Sizes and spacing of roof and ceiling framing members are indicated, along with the typical pitch of the roof. The roof shown in Figure 10-4 has an 8″ unit rise per foot of run.

The type, thickness, and R factor of insulation installed between the ceiling joists or rafters are shown. In Figure 10-4, 9¼″ thick insulation batts that are to be placed in the attic have an insulation value of R-30. Roof insulation materials are designed to provide a higher resistance to heat and cold transmission than wall insulation.

Plywood and oriented strand board are the most common materials for residential roof sheathing. In Figure 10-4, ½″ plywood is used as roof sheathing. Two layers of 15 lb asphalt-saturated felt are applied to the sheathing from the eaves line to 2′-0″ beyond the interior face of the exterior wall. The remainder of the wall is to be covered with one layer of 15 lb felt. The entire roof is to be finished with 285 lb seal-down asphalt shingles.

Fireplace Information

A floor plan provides some information regarding the construction of masonry fireplaces, but most of the information appears on sections or details. A vertical section is taken through the fireplace to show the components. See Figure 10-5. Prefabricated metal fireplaces are installed to simplify fireplace construction. Masonry may be applied as an exterior finish around the prefabricated metal firebox and flue.

Due to the weight of the masonry, extra structural support is required to provide a solid foundation for a masonry fireplace. Additional reinforcement or increased thickness of the floor or foundation will accommodate the additional weight and effectively fireproof the area.

The construction materials, type, and size of the hearth are shown on fireplace sections or details. Brick, concrete masonry units, stone, or ceramic and quarry tile create a fireproof hearth.

For a masonry fireplace, firebrick is used to construct the firebox. Firebrick can withstand high temperatures without crumbling and losing structural integrity. The depth, height, and shape of the firebox are dimensioned on sections or details. Firebox cleanouts, ash dumps, and intakes for outside combustion air into the firebox are also noted.

A damper at the top of the firebox allows the fireplace flue to be opened or closed. The size and location of the damper are noted. The flue carries smoke away from the firebox. Round or square clay building tile is the most common masonry flue lining material. Metal flue lining is used in prefabricated units. Flue lining material, type, and size are indicated on sections or details.

Exterior and interior wall finish materials for the fireplace area are noted on sections or details. These materials include brick, stone, concrete masonry units, wood, or gypsum board attached to furring. The mantle construction may also be detailed.

All beams, joists, studs, and other combustible materials must have a minimum clearance of 2″ from the front faces and sides of masonry fireplaces.

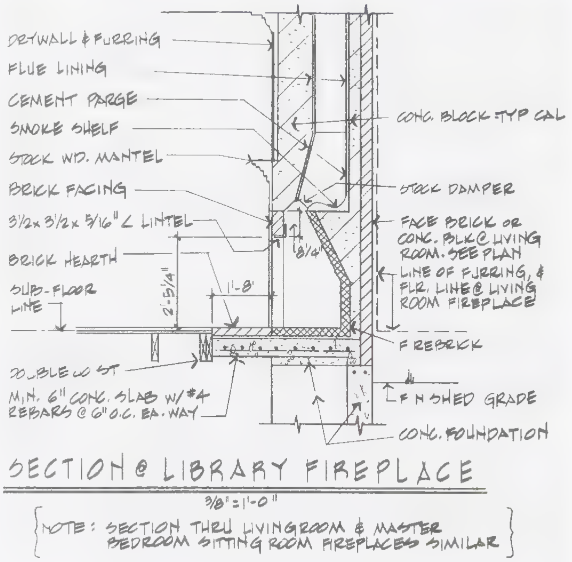


Figure 10-5. *Fireplace details describe the hearth, firebox, damper, flue, mantle, and interior and exterior finishes.*

Finish Sections

Details are provided for various finish materials. Finish sections and details are used in conjunction with interior elevations to provide information for special finishes, including special finishes for windows, doors, stairways, and moldings.

Windows and Doors. Window and door sections or details provide information about construction materials, sizes of jamb components, and types of opening mechanisms. Manufacturers use sections or details to provide architectural information about various window and door construction methods.

Cutting planes for sections or details are taken through the heads, side jambs, and window and door sills. See Figure 10-6. Three separate drawings are usually provided in a vertical pattern. The head section shows the construction along the head of the door or window, the sill section shows the construction along the bottom of the door or window, and the jamb section shows the jamb construction but is rotated and aligned with its mating parts in the sill. The head and sill sections are aligned to provide proper orientation.

Interior and exterior finish methods, flashing, and finish materials around the opening are also detailed. Window and door sections or details may also include information about the types of header framing or lintel installed above the openings.

Wall openings, such as windows and doors, must be properly flashed to prevent air infiltration in the house.

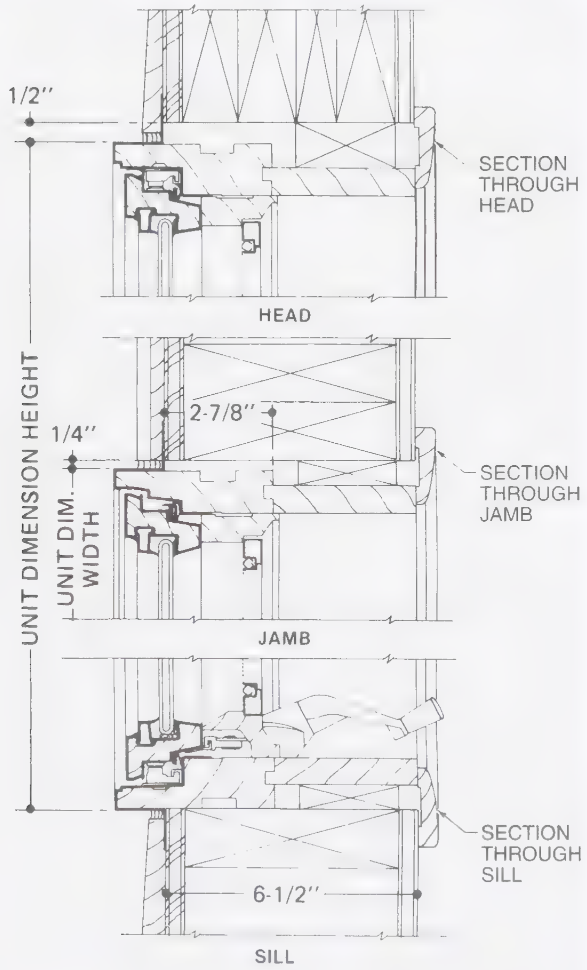


Figure 10-6. *Sections taken through window and door jambs provide dimensions and construction details.*

Stairways. Sections and details can be provided for exterior and interior stairways. Sections through stairways show construction materials used for stringers, risers, treads, landings, and handrails. See Figure 10-7. Vertical dimensions for headroom and handrail height may also be indicated. Special handrail components and stair finish materials are noted on details and may include manufacturer identification numbers for items such as balusters and newel posts.

Finish Moldings. Most finish moldings on sections or detail drawings are noted by size and name. Base molding is installed at the bottom of walls and may be trimmed at the floor level with an additional piece of shoe mold to provide a finished appearance. Crown mold is installed at wall and ceiling intersections. Chair rail is installed horizontally on a wall approximately 32″ above the finished floor. Panel mold is used to create panels on a wall both above and below chair rail. Casing is used to trim windows, doors, and other partition openings. Cove, quarter round, and outside corner molds are used to finish corners. See Figure 10-8.

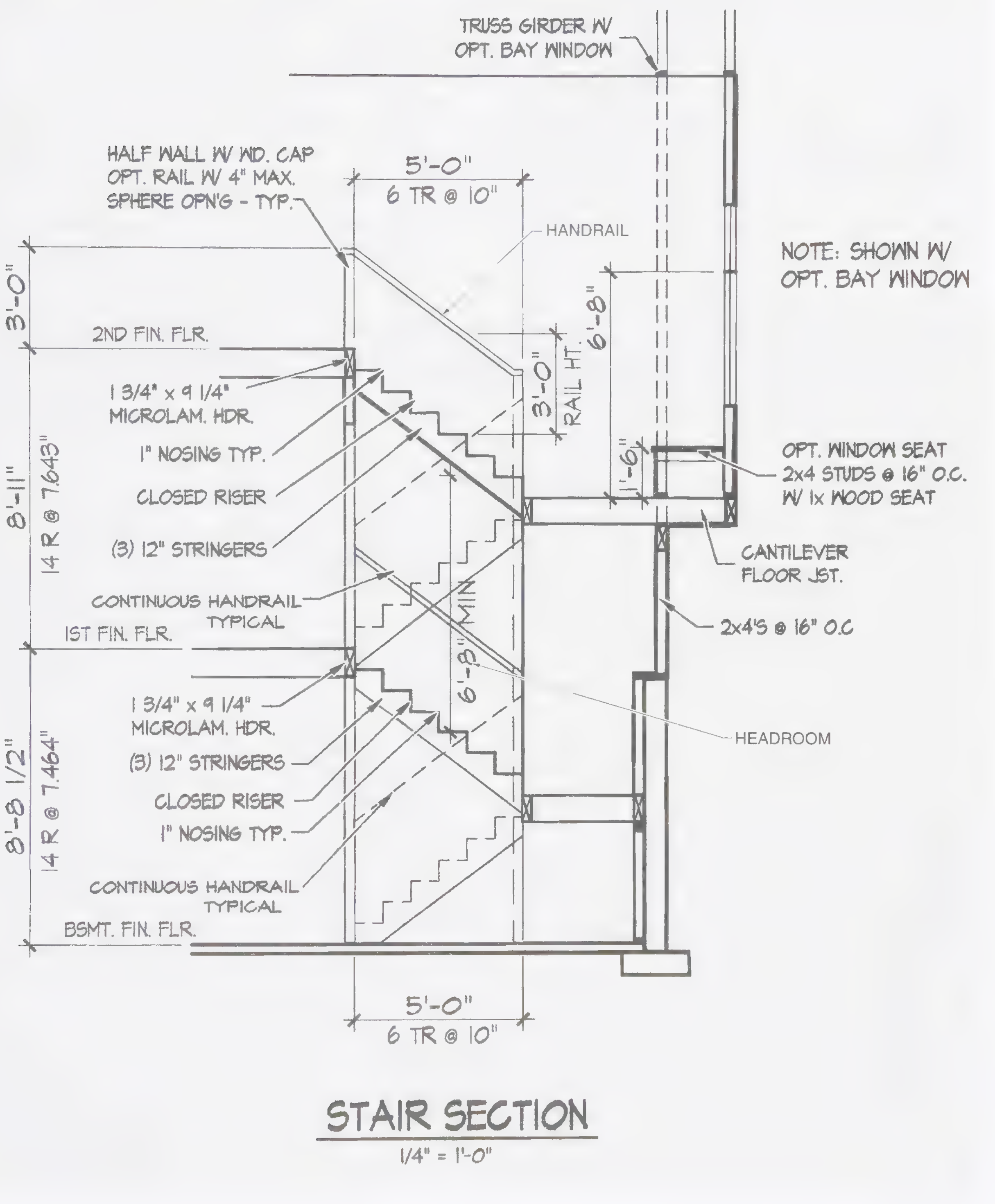


Figure 10-7. Stairway components and dimensions are shown on stairway sections.

A manufacturer's identification number may be indicated on sections or details for standard stock moldings. For custom houses, an architect may require the fabrication and installation of custom finish moldings that are not available as standard designs. A full-scale drawing of custom finish moldings may be included in the details showing the profile of the molding and the finish dimensions.

Cabinets. Cabinet details show specific sizes and styles of cabinets to be installed. Cabinets may be either stock (factory) cabinets or custom cabinets. The American National Standards Institute in conjunction with the Kitchen Cabinet Manufacturer's Association publishes standard dimensions for standard cabinets. For example, standard base cabinets are 24″ deep by 36″ high. Stock cabinets are manufactured in standard widths such as 12″, 18″, 24″, 30″, and 36″. A variety of widths may be interspersed throughout the kitchen based on the kitchen layout. Moldings and cabinet fillers are used to fill any open spaces in the cabinet layout. Custom cabinets are made to width based on specialized kitchen layouts. Wall cabinets are 12″ deep and 18″ to 42″ in height, with 30″ being a standard height.

Door design, cabinet hardware, finish, and countertop materials may be shown in interior elevations of the kitchen. See Figure 10-9. These elements are combined to provide various styles of cabinets. For example, raised panel doors, antique hardware, walnut-finished cabinets, and a granite countertop may be combined to form a complete kitchen installation.

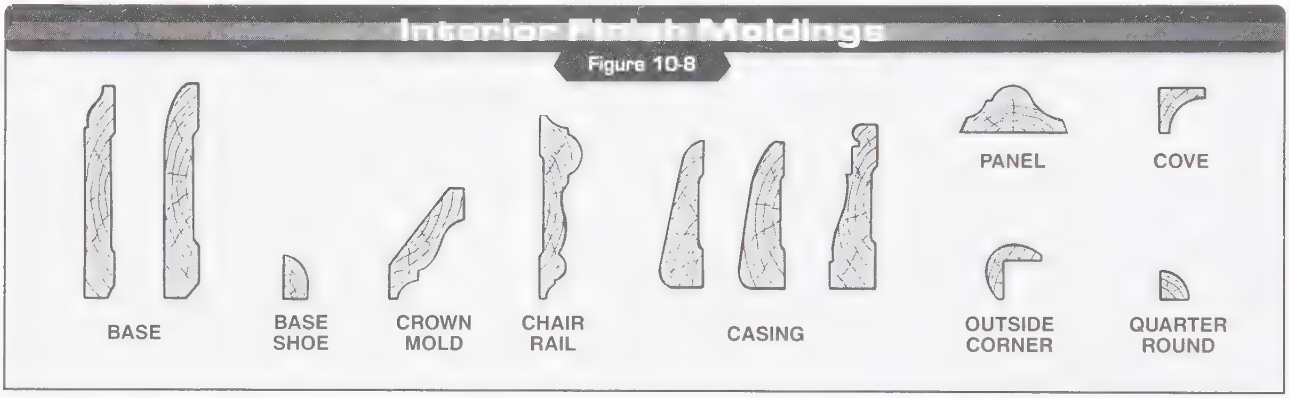


Figure 10-8. Interior finish moldings provide a finished appearance for walls, ceilings, and wall openings.

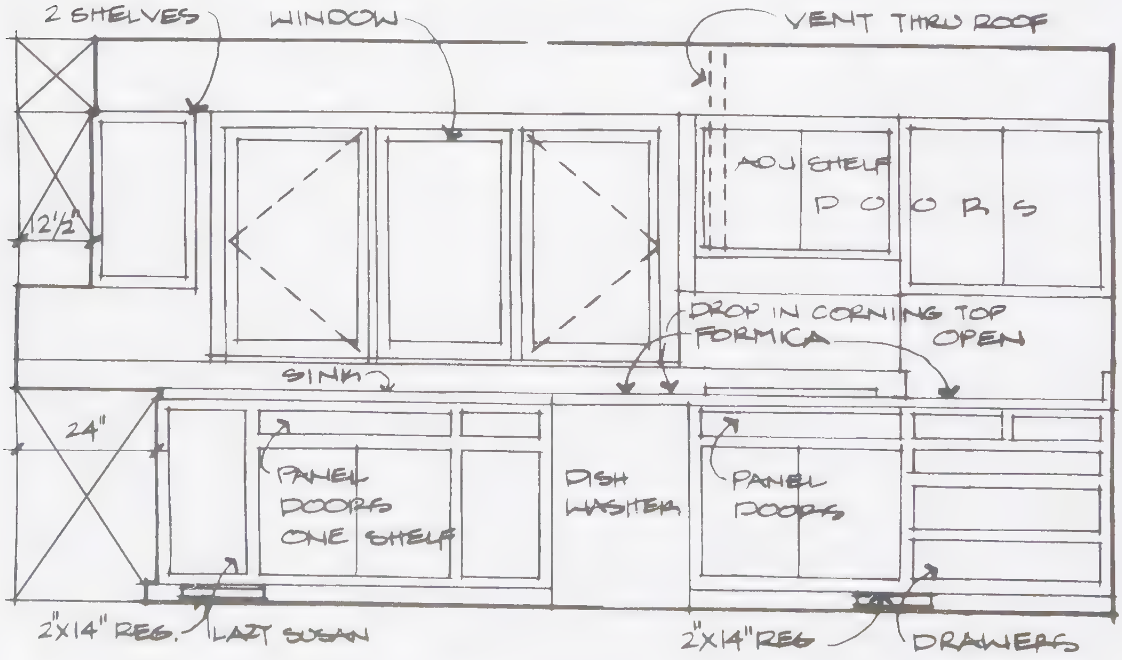


Figure 10-9. Kitchen elevations may provide additional information about cabinets.

ABBREVIATIONS AND SYMBOLS

Typical wall sections and other details describe many types of construction materials in a limited amount of space. Abbreviations and symbols allow the architect to include this information in as concise a manner as possible. See Figure 10-10.

Abbreviations

Section and detail abbreviations describe structural materials, interior and exterior finish materials, moldings, and other common materials. In addition, standard abbreviations used on other drawing sheets may be utilized to describe construction materials. See Figure 10-11.

Longitudinal and transverse sections are commonly included in residential prints. Passing a cutting plane through the long dimension of a house creates a longitudinal section. Passing a cutting plane through the short dimension of a house creates a transverse section.

Symbols

The imaginary slice through a given point or along a given line unveils interior construction details that cannot be described elsewhere in the prints. The symbols on sections and details show construction materials with various line patterns. See Figure 10-12.

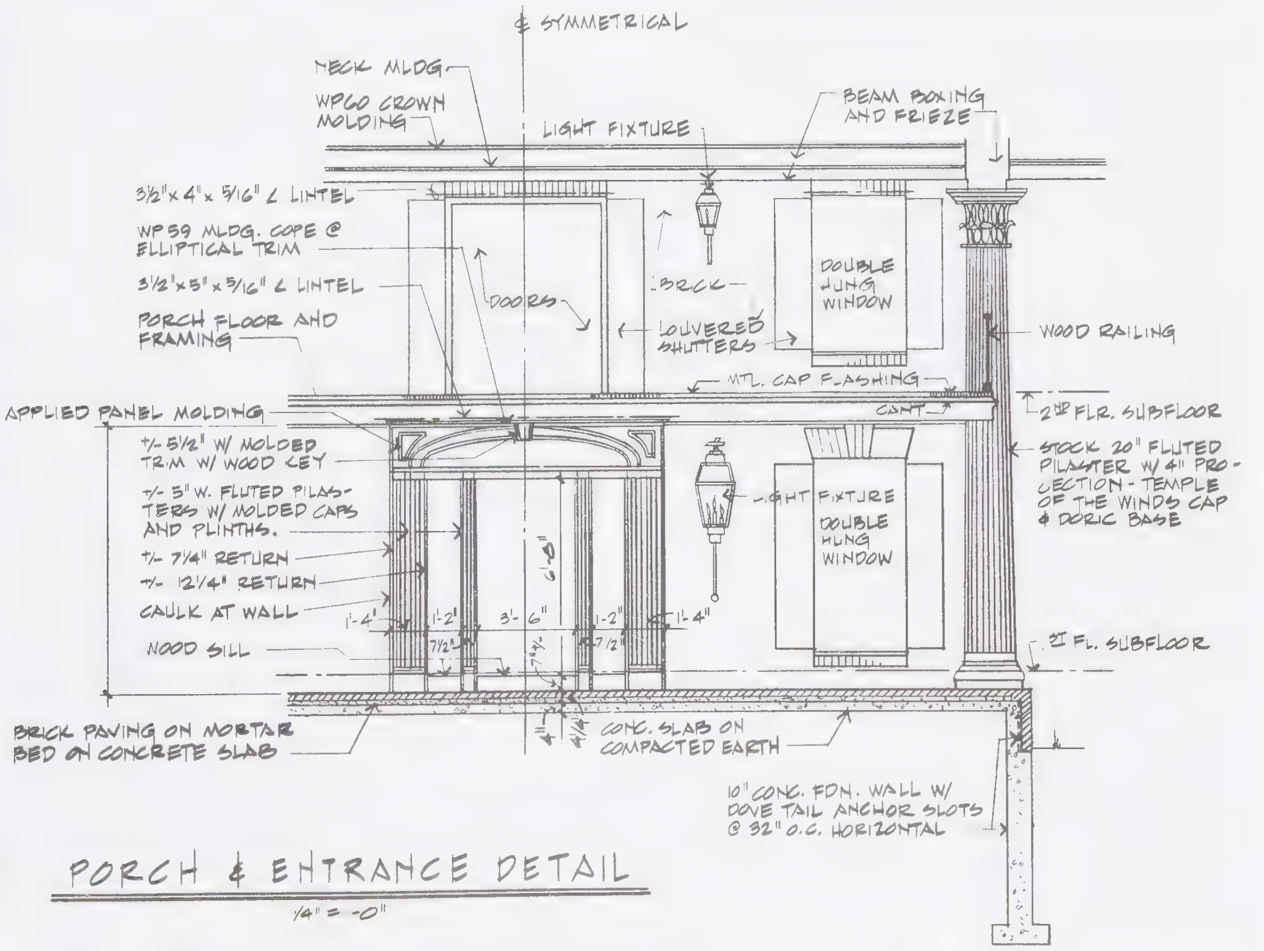


Figure 10-10. Wall sections show construction materials using abbreviations and symbols.

SECTION AND DETAIL ABBREVIATIONS			
Abbreviation	**Term**	**Abbreviation**	**Term**
ACT or AT	Acoustical tile	FNSH	Finish
ACST	Acoustic	FBCK	Firebrick
CAB.	Cabinet	FP	Fireplace
CSG	Casing	FRWK	Framework
CM	Center-matched	FR	Frame
CER	Ceramic	HBD	Hardboard
CHM	Chimney	JB or JMB	Jamb
CO	Cleanout	JT	Joint
COMB.	Combination	LAM	Laminate
CTR	Counter	MIR	Mirror
CO	Cut out	MLD or MLDG	Molding
DMPR	Damper	MRB or MR	Marble
DET or DTL	Detail	NOS	Nosing
DWL	Dowel	RTN	Return
D & M	Dressed and matched	SEC or SECT.	Section
E to E	End-to-end	SURF.	Surface
FAB	Fabricate	X SECT	Cross section

Figure 10-11. Sections and details use abbreviations to describe construction materials, components, and finishes.

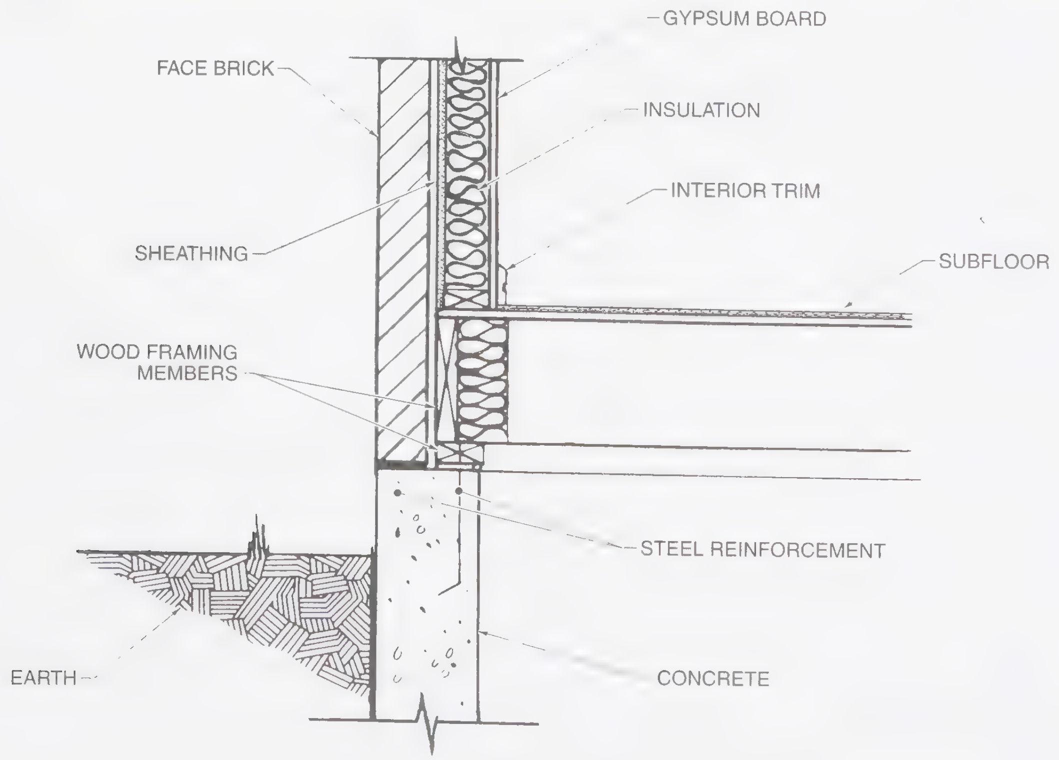


Figure 10-12. Symbols on section details represent materials that may not be clearly shown on other drawings.

REVIEW QUESTIONS

10

Sections and Details

Name ______________________________ Date ______________

True-False

T F 1. Sections and details are all included on a separate sheet.

T F 2. Arrows on cutting plane lines indicate the viewing direction for the section or detail.

T F 3. Insulation is typically placed between studs in exterior wood-framed walls.

T F 4. Soffit materials typically are not shown on details.

T F 5. Stairway details show the minimum headroom required for a set of stairs.

Identification

________________ 1. Crown mold

________________ 2. Base

________________ 3. Quarter round

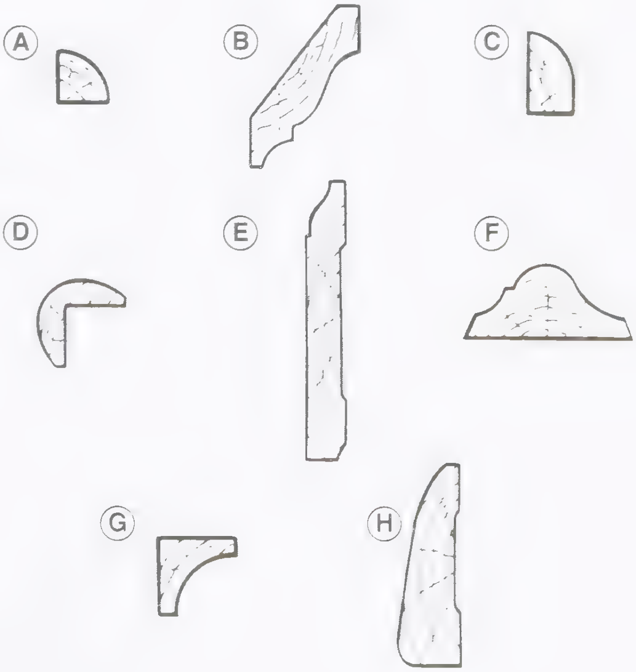
________________ 4. Casing

________________ 5. Outside corne

________________ 6. Panel mold

________________ 7. Base shoe

________________ 8. Cove



Abbreviations

Provide the abbreviations for the following terms.

_______________ 1. Cabinet

_______________ 2. Chimney

_______________ 3. Detail

_______________ 4. Finish

_______________ 5. Jamb

_______________ 6. Molding

_______________ 7. Section

Identification

Identify the building components on the typical wall section.

_______________ 1. Brick veneer

_______________ 2. Concrete footing

_______________ 3. Base mold

_______________ 4. Insulation

_______________ 5. Siding

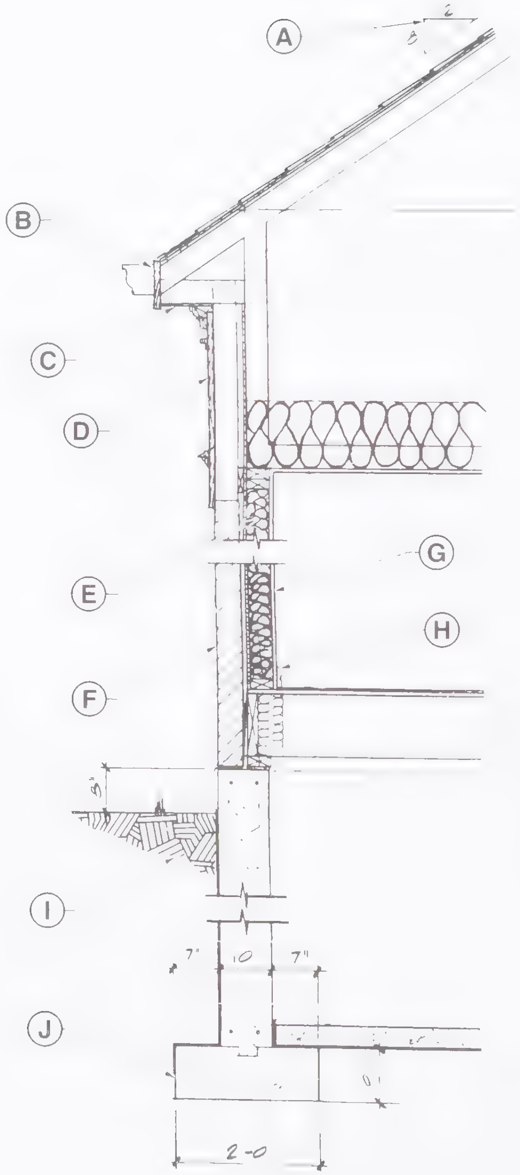
_______________ 6. Soffit

_______________ 7. Earth

_______________ 8. Gypsum board

_______________ 9. Fascia

_______________ 10. Slope diagram



Identify the fireplace components.

______________________ **11.** Mantle

______________________ **12.** Flue

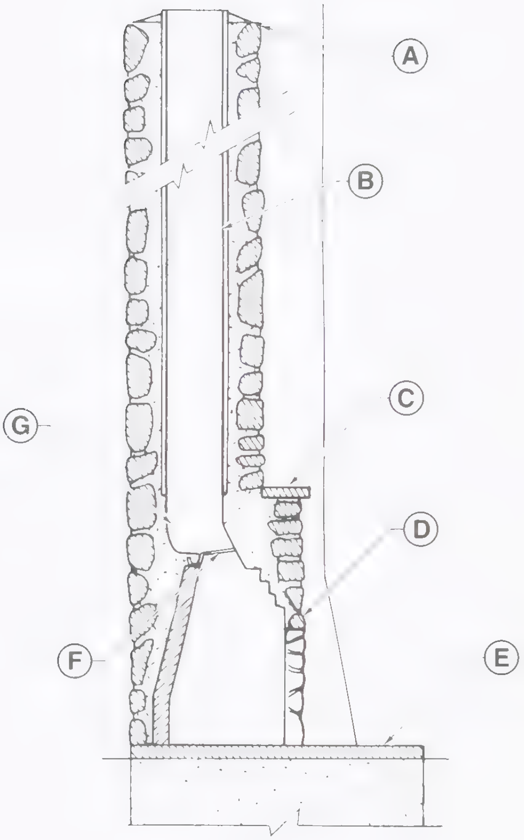
______________________ **13.** Concrete cap

______________________ **14.** Hearth

______________________ **15.** Damper

______________________ **16.** Smoke shelf

______________________ **17.** Lintel



Identify the symbols on the detail.

______________________ **18.** Concrete

______________________ **19.** Concrete masonry unit

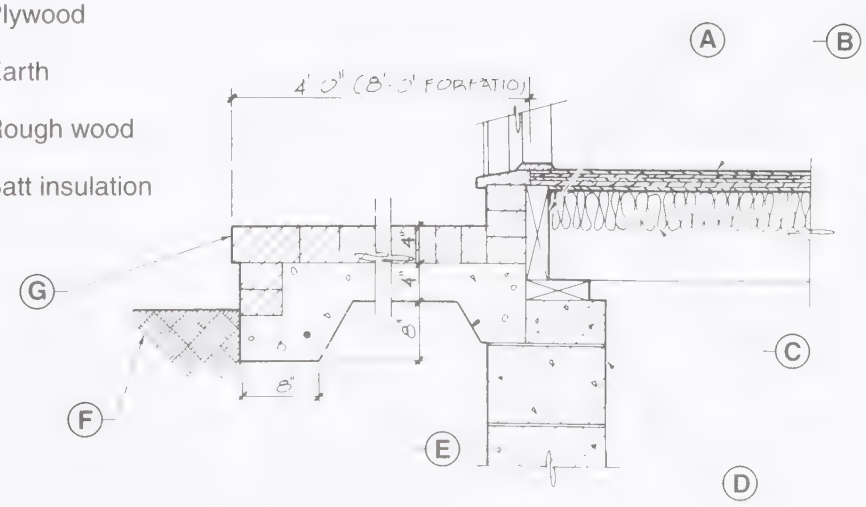
______________________ **20.** Face brick

______________________ **21.** Plywood

______________________ **22.** Earth

______________________ **23.** Rough wood

______________________ **24.** Batt insulation



Completion

_______________ 1. Steel reinforcement locations and types are shown on ___ details.

_______________ 2. A #6 steel rebar is ___″ in diameter.

_______________ 3. A slice taken vertically through the exterior wall that shows all common construction materials and methods in a house is a(n) ___.

Multiple Choice

_______________ 1. Details are drawn using a scale ___ the scale used for other types of drawings.

A. larger than
B. smaller than
C. the same size as
D. none of the above

_______________ 2. The first two numbers used to describe welded wire reinforcement indicate the ___.

A. wire size
B. depth of reinforcements
C. wire spacing
D. types of welds

_______________ 3. Drain tile is installed along the ___.

A. soffit
B. footing
C. bathroom
D. kitchen

_______________ 4. For window and door sections, the sections appear in the order of ___ from top to bottom.

A. head, sill, and jamb
B. sill, jamb, and head
C. jamb, head, and sill
D. head, jamb, and sill

_______________ 5. Full-scale (FS) details are used to show ___.

A. soffits
B. custom moldings
C. stairways
D. foundation reinforcement

CHAPTER 11

Specifications

Specifications are a written legal document provided as part of a set of residential prints. The specifications, often referred to as "specs," include information concerning construction materials and methods and the responsibilities of the owner and builders.

Residential structures do not require as large a set of specifications as are included in commercial building prints. Specifications for a residential structure may be included on the prints or as a separate document. Specifications may also be included as part of the sales agreement between the owner and builder.

Specifications clearly define the required materials and building practices for house construction. With these items defined, disputes between builders and owners are less likely to arise.

TYPES OF WRITTEN INFORMATION

Specifications provide detailed written information about construction materials, exterior and interior finishes, electrical luminaires and devices, plumbing fixtures, and heating and air conditioning equipment. See Figure 11-1. In addition to the descriptions of building components, the specifications often include dollar amounts, manufacturer names, and brand names. The cover sheet, or beginning of the specifications, typically describes the location of the house and lists the names of the builder and owner. For ease of reading, the information in the specifications is separated into several divisions.

General conditions of construction are included as part of the specifications. The general conditions describe the house building practices and procedures and any other stipulations of construction requested by the owner or architect.

Divisions

General headings define and classify the information included in the specifications. See Figure 11-2. Divisions can vary from builder to builder and with the types of residential construction methods. Standard formats are also available for divisions of specification information.

Divisions may be categorized by building components or by construction materials. For example, divisions can be entitled "Concrete" and "Lumber," or "Foundation" and "Walls." Common divisions include masonry, concrete (foundations, walkways, and driveways), electrical, plumbing, excavation, heating and air conditioning, cabinetry, and painting. More detailed divisions are provided as required.

Standardized Formats. Various governmental agencies, such as the Federal Housing Administration (FHA), provide a standard form for residential specifications. A standard form is required for homes financed with government-insured loans. Because of the form's standard presentation of building components and materials, it may also be used in its original form or with slight changes by builders or owners not having government-insured loans.

Discrepancies between the prints and specifications may be noted when working with residential prints. If discrepancies occur, information in the specifications takes precedence over the prints.

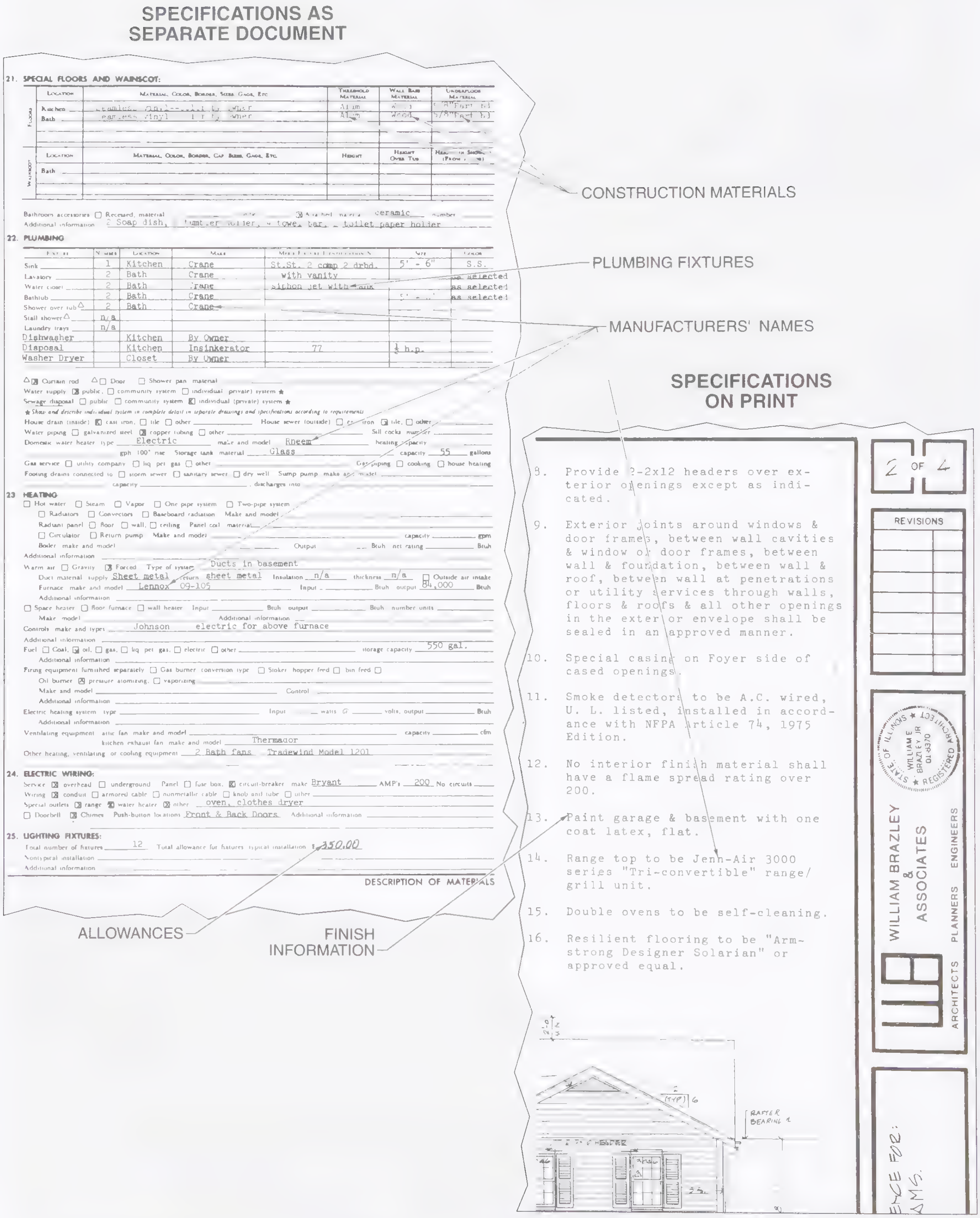


Figure 11-1. Specifications provide detailed information about construction materials and methods.

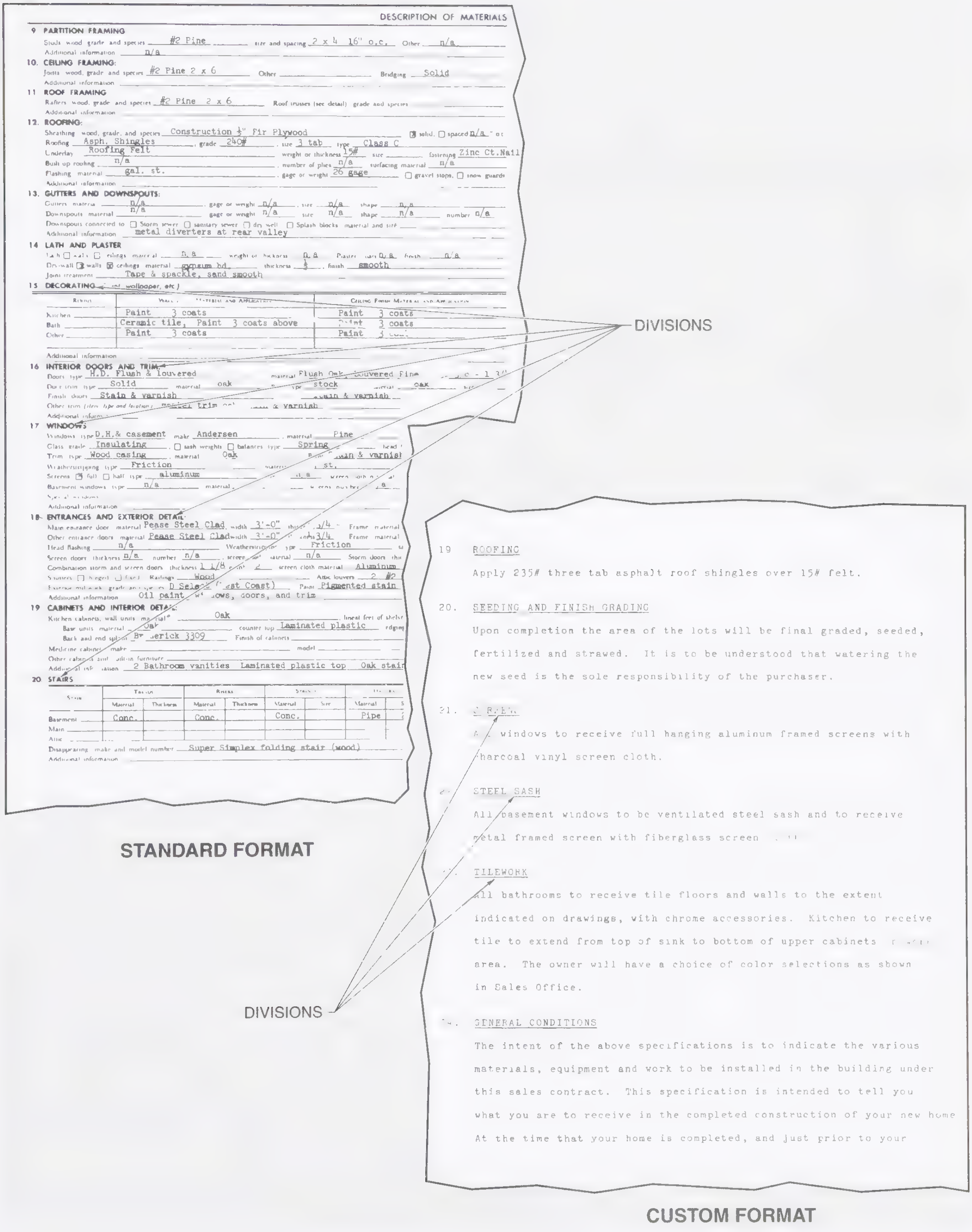


Figure 11-2. *Information in specifications is separated into several divisions using standard or custom formats.*

The Construction Specifications Institute (CSI) has also developed standard divisions for types of construction work. However, these divisions are more commonly used for commercial construction specifications.

Materials

Detailed information about the types and grades of construction materials is also included in the specifications. This information is helpful to the builder when performing takeoffs or estimates of construction materials. Written descriptions of structural, finish, and insulation materials are also typically included.

Structural. Grades, types, and strengths of lumber, wood products, concrete, and masonry structural components are included in the specifications. This information ensures that construction materials conform to required load capacities.

Lumber is commonly classified as yard lumber or structural lumber. See Figure 11-3. Boards and light-framing lumber are yard lumber. The eight grades of boards and light-framing lumber are Select Structural, Construction, Standard, Utility, Stud, No. 1, No. 2, and No. 3. Framing lumber is graded based on the number of knots and other deformities allowed in each board.

Southern Forest Products Association

Lumber is graded and sorted according to thickness, width, and length as it moves along a conveyor belt at the sawmill.

Joists and planks are classified as structural lumber. Structural lumber is graded using a type and number system, according to the type of wood. A No. 2 or better grade of structural lumber is normally required for adequate structural support in residential construction. The lumber grade and the type of wood are included in the specifications. Pine and fir are two common woods used for frame construction.

Plywood and other wood panel products are also noted in the specifications. Each face of a sheet of plywood is graded with a letter code—A, B, C, or D. A is the highest grade and D is the lowest. A piece of plywood graded C/D has one C-grade face and one D-grade face. C/D grade plywood is used for most residential structural applications.

Plywood is also noted as interior or exterior grade based on the type of adhesive used in manufacturing the panels. Other wood products, such as oriented strand board and particleboard, are described in the specifications. Manufacturer trade names and identifying codes may be written in the specifications for these products.

Oriented strand board (OSB) is commonly used for wall and roof sheathing and for subfloors. OSB is manufactured from mechanically oriented wood strands that are bonded with a waterproof adhesive.

Concrete is described in the specifications by the number of sacks of cement contained in each cubic yard of concrete mixture. See Figure 11-4. More sacks of cement per cubic yard of concrete result in stronger finished concrete. A "five bag" mix is common in residential specifications. The proportions of water and aggregate included in the concrete mix may also be noted.

Concrete may also be described in the specifications by noting its 28-day strength. To determine the 28-day strength, a test cylinder is filled with concrete at the time the concrete is placed in the forms. After 28 days, the concrete cylinder is compressed and shattered at a testing laboratory. The strength of the concrete is then measured in pounds per square inch (psi). Types and sizes of reinforcement for concrete footings, walls, and slabs are also commonly included in the specifications.

Types of masonry units, including concrete masonry units, brick, and stone, are noted in residential specifications. The type and color of mortar may also be specified. The four mortar types are M, S, N, and O. Type M is a general-purpose mortar and is the most common type used in residential construction. Reinforcement installed in masonry walls may also be noted in the specifications.

2. CARPENTRY AND LUMBER

Floor joists to be 2" x 10" or 2" x 12", according to plan, No. 2 or better yellow pine. Partition studs to be 2" x 4" K.D. construction grade. Ceiling joists and roof rafters to be construction or engineered roof trusses of yellow pine. Sub-floor to be 3/4" thick plywood. Roof sheathing to be 1/2" thick plywood.

All exterior trim to be Upson trim-bilt or equivalent exterior grade lumber of sizes and thickness as shown on plans. Insulite or Masonite lapsiding or board and batten siding to be used where siding is shown, unless other siding is shown on plans. Family room paneling to be 1/4" x 4' x 8' Birch plywood.

LUMBER SPECIFICATIONS

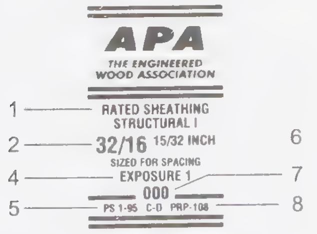
LUMBER GRADES

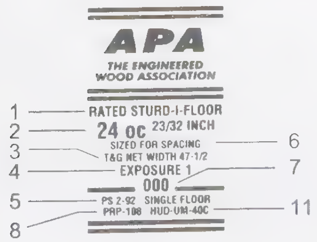
FRAMING GRADE LUMBER

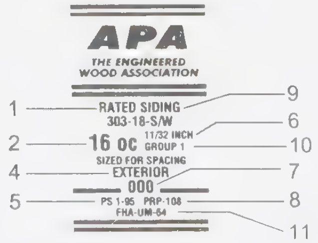
PRODUCT	GRADES	APPLICATIONS
Structural Light Framing (SLF) (2 x 2 through 4 x 4)	Select Structural No. 1 No. 2 No. 3	Structural applications where high-strength design values are required in light framing sizes
Light Framing (LF) (2 x 2 through 4 x 4)	Construction Standard Utility	Basic framing lumber for wall framing, plates, sills, cripple studs, blocking, and similar applications
Stud (2 x 2 through 4 x 18)	Stud	All-purpose grade designed primarily for stud uses, including load-bearing walls
Structural Joists and Planks (SJ&P) (2 x 5 through 5 x 18)	Select Structural No. 1 No. 2 No. 3	Intended for engineering applications for lumber 5" and wider, such as joists, rafters, headers, beams, trusses, and general framing

* Douglas fir or Douglas fir-larch only

Western Wood Products Association







1. Panel Grade
2. Span Rating
3. Tongue-and-groove
4. Exposure durability rating
5. Product Standard
6. Thickness
7. Mill number
8. APA's Performance Rated Panel Standard
9. Siding face grade
10. Species group number
11. HUD/FHA recognition

Figure 11-3. Lumber and wood products are described in the specifications.

3. CONCRETE WORK

Concrete for footings and foundation walls for house and garage to be 5 sacks cement per cubic yard of concrete aggregate. Provide concrete footings and foundation walls as indicated on drawings. Basement floor to be 3" thick concrete laid on 3" crushed rock. Open porch floors to be 4" thick concrete laid over level ground and reinforced with #4 reinforcing rods or 6 x 6, 10 x 10 wire mesh. Garage floor to be 4" thick concrete sloped toward garage door.

MIXTURE PROPORTION

REINFORCEMENT

CONCRETE SPECIFICATIONS

STRENGTH

2. FOUNDATIONS:

Footings concrete mix 5 bag mix; strength psi 2500 Reinforcing 2 - #4 bars
Foundation wall material Concrete masonry units Reinforcing horiz steel alt. courses
Interior foundation wall material n/a Party foundation wall n/a
Columns: material and sizes $3\frac{1}{2}$" std. pipe col. Piers: material and reinforcing n/a
Girders material and sizes W 8 x 17 Sills material 2 x 6
Basement entrance areaway CMU Walls conc fl. Window areaways n/a
Waterproofing 1 coat pitch, polyethylene sheet Footing drains drain tile sump pump for basement
Termite protection chlordane soil treatment
Basementless space: ground cover n/a; insulation n/a; foundation vents n/a
Special foundations stepped footings at R & L sides. Fireplace footing conc. 2 #5 bars 12'-0" lg.
Additional information: Grade beam at garage entrance 2 #4 bars.

MASONRY SPECIFICATIONS

Type M Mortar. This mortar is suitable for general use and is recommended specifically for masonry below grade and in contact with earth. It consists of 1 part portland cement, ¼ part hydrated lime or lime putty, 3 parts sand by volume *or* 1 part portland cement, 1 part masonry cement, and 6 parts sand by volume.

Type S Mortar. This is also a general purpose mortar bond and is recommended where high resistance to lateral force is required. It consists of 1 part portland cement, ½ part hydrated lime or lime putty, 4½ parts sand by volume *or* ½ part portland cement, 1 part masonry cement, and 4½ parts sand by volume.

Type N Mortar. This mortar is suitable in exposed masonry above grade and is recommended specifically for exterior walls subjected to severe exposure. It consists of 1 part portland cement, 1 part hydrated lime or lime putty, 6 parts sand by volume *or* 1 part masonry cement, and 3 parts sand by volume.

Type O Mortar. This mortar is recommended for load-bearing walls of solid units where the compressive stresses do not exceed 100 lb per sq in. and the masonry will not be subjected to freezing and thawing in the presence of excessive moisture. It consists of 1 part portland cement, 2 parts hydrated lime or lime putty, 9 parts sand by volume *or* 1 part masonry cement, and 3 parts sand by volume.

TYPES OF MORTAR

Figure 11-4. Types, strengths, and required reinforcement are shown for concrete and masonry construction.

Finish. Exterior and interior finish materials are described in the specifications. These include lumber, masonry, gypsum board, tile, paint, floor coverings, roofing, doors, windows, hardware, cabinetry, and landscaping.

Exterior siding is noted by the type and possibly the manufacturer's name. Interior finish moldings, including stairway materials, are noted by grade, size, and manufacturers' names and identification codes. The type of wood and the final finish treatment is noted for wood paneling.

Finish masonry for masonry veneer and fireplace construction is described in the specifications. See Figure 11-5. The style and color of brick or type of stone is listed for veneer application. Materials for fireplace construction and other finish masonry materials are also noted.

The thicknesses and fire ratings are indicated for interior wall finish materials such as gypsum board and tile. Colors are noted for tile, paint, and other interior finish wallcoverings. The number of coats of paint for covering various areas such as closets, walls, ceilings, exterior siding, and trim may also be noted.

Interior gypsum board consists of a fire-resistant core that is encased in heavy paper on both sides. The core and heavy paper may be treated.

Floor coverings for each room are described by the type of covering (hardwood, tile, resilient flooring, or carpeting) and the manufacturer's name and identifying number.

The type of roof covering is noted in residential specifications. For shingles, the weight per square and application method may be noted.

Styles, finishes, and door and window manufacturers' names are included in the specifications. See Figure 11-6. Screens, types of glass, and hardware for doors and windows are also shown. Hardware is noted by the style, manufacturer's name, and type of finish.

Cabinetry finish and manufacturer may be included in the specifications. An allowance is a dollar amount noted in the specifications for fixtures and installations such as cabinetry. The specifications also include descriptions of built-in kitchen appliances and bathroom cabinets.

The finish of the building lot (sodded, seeded, or unfinished) and landscaping are also described in the specifications. The specifications may provide a landscaping allowance.

Information regarding cabinetry finish and manufacturer may be included in the specifications.

Fixtures

Floor plans and elevations indicate locations of plumbing fixtures and electrical luminaires and devices. The specifications provide written descriptions of the styles and types of luminaires and devices to be installed. Along with these descriptions, the specifications provide information about the electrical and plumbing services supplied, including a statement requiring that electrical and plumbing work be performed according to applicable local building codes.

Electrical. Descriptions for electrical work include luminaires (lighting fixtures), and devices such as switches, smoke detectors, and appliances. See Figure 11-7. An electrical fixture allowance is commonly included in the specifications.

In addition to the electrical fixture information, the type of wiring and number of circuits may also be described in the specifications. The type of electrical service (overhead or lateral), main service panelboard, and cable to be installed may be noted.

Plumbing. The sizes, manufacturers' names, code numbers, and colors of plumbing fixtures are described in the specifications. See Figure 11-8. The size and type of water heater is also included. Plumbing pipe type and size and sump pumps installed for basement drainage are also described.

FINISH LUMBER

MILLWORK

Interior doors to be masonite moulded face 6 panel colonial.

All exterior doors to be 1-3/4" thick, of design shown on plans.

Interior trim to be 3-1/4" pine colonial. Exterior windows shall be Caradco Insulated Glass.

STAIRS

Stair	Treads		Risers		Strings		Handrail		Balusters	
	Material	Thickness	Material	Thickness	Material	Size	Material	Size	Material	Size
Basement	Oak	5/4"	Pine	3/4"	Fir	2"x12"	Birch	[illegible]	[illegible]	[illegible]
Main										
Attic										

Disappearing: make and model number

Additional information

TILE

TILEWORK

All bathrooms to receive tile floors and walls to the extent indicated on drawings, with chrome accessories. Kitchen to receive tile to extend from top of sink to bottom of upper cabinets in work area. The owner will have a choice of color selections as shown in Sales Office.

ROOFING

ROOFING
Sheathing: wood, grade, and species Construction ½" Fir Plywood ☒ solid ☐ spaced n/a " o.c.
Roofing Asph. Shingles ; grade 240# ; size 3 tab ; type Class C
Underlay Roofing Felt ; weight or thickness 15# ; size ; fastening Zinc Ct.Nail
Built-up roofing n/a ; number of plies n/a ; surfacing material n/a
Flashing: material gal. st. ; gage or weight 26 gage ; ☐ gravel stops ; ☐ snow guards
Additional information:

FIREPLACE MASONRY

CHIMNEYS:
Material Face Brick & C.M.U. Prefabricated (make and size) n/a
Flue lining Tile & vit. tile Heater flue size 8" vit. tile Fireplace flue size 12 x 12
Vents (material and size): gas or oil heater n/a ; water heater n/a
Additional information: Incinerator flue 12 x 12

FIREPLACES:
Type: ☒ solid fuel; ☐ gas-burning; ☐ circulator (make and size) n/a Ash dump and clean-out 10 inch
Fireplace: facing Face brick ; lining Fire brick ; hearth Q tile ; mantel n/a
Additional information:

GENERAL NOTES

1. Double all joists under partitions parallel to joist span.
2. Triple all joists under bearing partitions parallel to joists span.
3. Provide one layer of ½" drywall all walls and ceilings.
4. All doors to be 6 panel or 3 panel molded face.
5. Fire stop all dropped ceilings and soffits.
6. All nailing to comply with BOCA Basic Building Code Appendix M.
7. Drywall installation to be in accordance with Gypsum Assoc. recommended practice for thickness, nailing & taping on correct stud spacing. Use water resistant drywall at bathtubs and shower areas.

GYPSUM BOARD

PAINTING

LATH AND PLASTER
Lath ☐ walls ☐ ceilings: material n/a ; weight or thickness n/a Plaster: coats n/a ; finish n/a
Dry-wall ☒ walls ☒ ceilings: material gypsum bd. ; thickness ½ ; finish smooth
Joint treatment Tape & spackle, sand smooth

DECORATING (Paint, wallpaper, etc.)

Rooms	Wall Finish Material and Application	Ceiling Finish Material and Application
Kitchen	Paint 3 coats	Paint 3 coats
Bath	Ceramic tile, Paint 3 coats above	Paint 3 coats
Other	Paint 3 coats	Paint 3 coats

Additional information:

FLOORING

SPECIAL FLOORS AND WAINSCOT:

Floors:

Location	Material, Color, Border, Sizes, Gage, Etc.	Threshold Material	Wall Base Material	Underfloor Material
Kitchen	Seamless vinyl--color by owner	Alum.	Wood	5/8"Part.bd.
Bath	Seamless vinyl--color by owner	Alum.	Wood	5/8"Part.bd.

Wainscot:

Location	Material, Color, Border, Cap. Sizes, Gage, Etc.	Height	Height Over Tub	Height in Showers (From Floor)
Bath				

Bathroom accessories: ☐ Recessed; material ; number ; ☐ Attached; material ; number
Additional information:

Figure 11-5. Various exterior and interior finish materials are noted in the specifications.

TYPE OF GLASS

MANUFACTURER'S NAME

16. INTERIOR DOORS AND TRIM:

Doors type H.D. Flush & louvered, material Flush Oak, Louvered Pine, thickness 1 3/8 - 1 3/4
Door trim type Solid, material oak Base type stock, material oak, size n/a
Finish doors Stain & varnish, trim stain & varnish
Other trim *(item, type and location)* mantel trim oak stain & varnish
Additional information

17. WINDOWS:

Windows type D.H.& casement, make Andersen, material Pine, sash thickness 1 3/8
Glass grade Insulating, ☐ sash weights, ☐ balances, type Spring, head flashing n/a
Trim type Wood casing, material Oak Paint Stain & varnish, number coats 2
Weatherstripping type Friction, material st. st. Storm sash, number n/a
Screens ☑ full; ☐ half; type aluminum, number n/a, screen cloth material n/a
Basement windows type n/a, material n/a, screens, number n/a, Storm sash, number n/a
Special windows
Additional information

18. ENTRANCES AND EXTERIOR DETAIL:

Main entrance door material Pease Steel Clad, width 3'-0", thickness 1 3/4" Frame material Pine, thickness 1 3/8"
Other entrance doors material Pease Steel Clad width 3'-0", thickness 1 3/4" Frame material Pine, thickness 1 3/8"
Head flashing n/a Weatherstripping type Friction, saddles n/a
Screen doors thickness n/a", number n/a, screen cloth material n/a Storm doors thickness n/a", number n/a
Combination storm and screen doors thickness 1 1/8, number 2, screen cloth material Aluminum
Shutters ☐ hinged, ☐ fixed Railings Wood, Attic louvers 2 #2 Pine
Exterior millwork grade and species D Select (West Coast) Paint Pigmented stain, number coats 2
Additional information Oil paint windows, doors, and trim

19. CABINETS AND INTERIOR DETAIL:

Kitchen cabinets, wall units material Oak, lineal feet of shelves 28', shelf width 12"
Base units material Oak, counter top Laminated plastic, edging Laminated plastic
Back and end splash Broderick 3309 Finish of cabinets, number coats
Medicine cabinets make, model
Other cabinets and built-in furniture
Additional information 2 Bathroom vanities Laminated plastic top Oak stain & varnish

CABINETRY ALLOWANCE

APPLIANCES

CABINETRY

Kitchen cabinets, vanities, bar cabinet, desks, utility cabinets (if shown on plan), sink top and bowl, vanity tops, bar top, desk top, utility cabinet top, all are a part of cabinetry allowance which shall be $8000.00.

Built Ins:

Dishwasher: Kitchen Aid (KDS-19) Disposal: Furnished & Installed by plumber

Built-In Ovens: G.E. Microwave above with self-cleaning below (JKP-97) Range Top: Jennaire 88890 + One 89904 Cartridge

FINISH HARDWARE

To be polished brass finish Schlage Series "A". The front and rear doors are to be keyed alike. All butts are to be of standard grade. All exterior doors to include dead bolt locks keyed alike with door locks.

HARDWARE

Figure 11-6. Specifications describe windows, doors, cabinetry, and their hardware.

ELECTRIC WIRING

To be installed in accordance with the electric code of St. Louis County and according to plans. All electric fixtures are to be installed by this contractor. The electric service to be 200 ampere service with circuit breaker panel. All light switches to be the silent type. Exhaust fans for kitchen and inside baths will be installed.

ELECTRIC FIXTURES

The purchaser is given a choice of his own electrical fixtures at a supplier designated by the Builder with an allowance of $2500.00 (builder's cost).
NOTE: Door chimes to be a part of this allowance and chosen at the same time. All recessed fixtures chosen by Buyer or shown on plans are from the above allowance.

CODE STATEMENT
TYPES OF FIXTURES
FIXTURE ALLOWANCE

Figure 11-7. Residential electrical specifications include information about electrical devices and wiring.

22. PLUMBING:

FIXTURE	NUMBER	LOCATION	MAKE	MFR'S FIXTURE IDENTIFICATION NO	SIZE	COLOR
Sink	1	Kitchen	Crane	St.St. 2 comp 2 drbd.	5' - 6"	S.S.
Lavatory	2	Bath	Crane	with vanity		as selected
Water closet	2	Bath	Crane	siphon jet with tank		as selected
Bathtub	2	Bath	Crane		5' - 0"	as selected
Shower over tub△	2	Bath	Crane			
Stall shower△	n/a					
Laundry trays	n/a					
Dishwasher		Kitchen	By Owner			
Disposal		Kitchen	Insinkerator	77	½ h.p.	
Washer Dryer		Closet	By Owner			

△☒ Curtain rod △☐ Door ☐ Shower pan: material ______

Water supply: ☒ public; ☐ community system; ☐ individual (private) system.★

Sewage disposal: ☐ public; ☐ community system, ☒ individual (private) system.★

★*Show and describe individual system in complete detail in separate drawings and specifications according to requirements.*

House drain (inside): ☒ cast iron; ☐ tile; ☐ other ______ House sewer (outside): ☐ cast iron, ☒ tile; ☐ other ______

Water piping: ☐ galvanized steel. ☒ copper tubing; ☐ other ______ Sill cocks, number ______

Domestic water heater: type Electric; make and model Rheem; heating capacity ______

______ gph. 100° rise. Storage tank: material Glass; capacity 55 gallons

Gas service: ☒ utility company; ☐ liq. pet. gas; ☐ other ______ Gas piping: ☐ cooking; ☐ house heating.

Footing drains connected to: ☐ storm sewer; ☐ sanitary sewer; ☐ dry well. Sump pump; make and model ______

______; capacity ______; discharges into ______

FIXTURES
PIPE INFORMATION
WATER HEATER

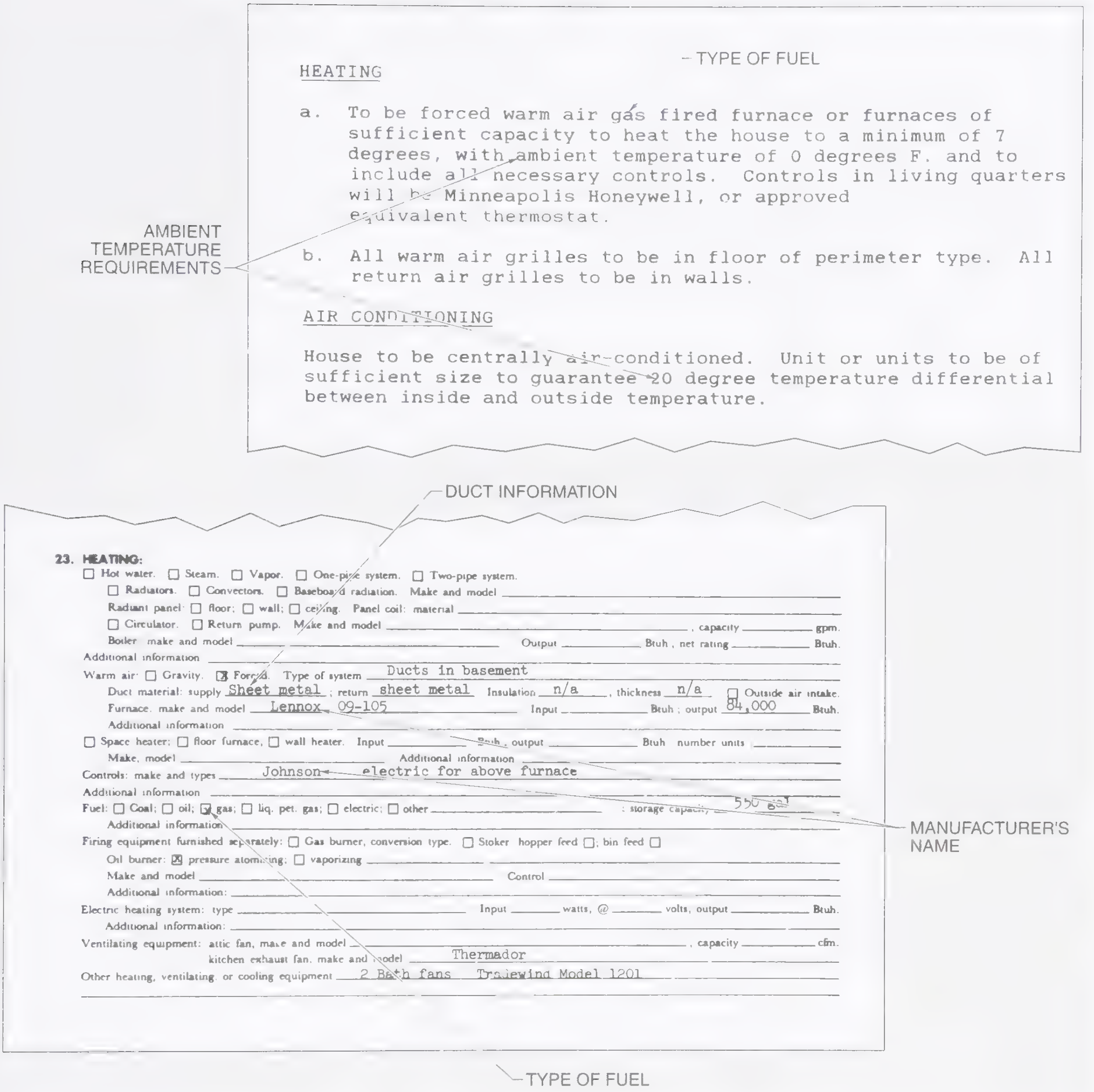
Figure 11-8. Plumbing fixture finishes and manufacturers' names are included in the specifications.

Mechanical Equipment

Heating and air conditioning equipment is described in the specifications by the equipment manufacturer's name and the type of heating or cooling system. See Figure 11-9. The heating and cooling system requirements may be noted in terms of the system's ability to maintain a given temperature in relation to the ambient outside temperature.

Materials to be used for ductwork and piping are given. The type of heating fuel is noted. Locations and descriptions may also be given for registers and other sheet metal work. Thermostat type may also be included in the specifications.

Piping for plumbing and heating, ventilating, and air conditioning (HVAC) systems is typically not shown on residential prints.



HEATING

a. To be forced warm air gas fired furnace or furnaces of sufficient capacity to heat the house to a minimum of 7 degrees, with ambient temperature of 0 degrees F. and to include all necessary controls. Controls in living quarters will be Minneapolis Honeywell, or approved equivalent thermostat.

b. All warm air grilles to be in floor of perimeter type. All return air grilles to be in walls.

AIR CONDITIONING

House to be centrally air-conditioned. Unit or units to be of sufficient size to guarantee 20 degree temperature differential between inside and outside temperature.

23. HEATING:

☐ Hot water. ☐ Steam. ☐ Vapor. ☐ One-pipe system. ☐ Two-pipe system.
☐ Radiators. ☐ Convectors. ☐ Baseboard radiation. Make and model ______
Radiant panel: ☐ floor; ☐ wall; ☐ ceiling. Panel coil: material ______
☐ Circulator. ☐ Return pump. Make and model ______, capacity ______ gpm.
Boiler: make and model ______ Output ______ Btuh., net rating ______ Btuh.
Additional information ______
Warm air: ☐ Gravity. ☒ Forced. Type of system Ducts in basement
Duct material: supply Sheet metal ; return sheet metal Insulation n/a , thickness n/a ☐ Outside air intake.
Furnace: make and model Lennox 09-105 Input ______ Btuh.; output 84,000 Btuh.
Additional information ______
☐ Space heater; ☐ floor furnace; ☐ wall heater. Input ______ Btuh.; output ______ Btuh. number units ______
Make, model ______ Additional information ______
Controls: make and types Johnson electric for above furnace
Additional information ______
Fuel: ☐ Coal; ☐ oil; ☒ gas; ☐ liq. pet. gas; ☐ electric; ☐ other ______ ; storage capacity 550 gal
Additional information ______
Firing equipment furnished separately: ☐ Gas burner, conversion type. ☐ Stoker: hopper feed ☐; bin feed ☐
Oil burner: ☒ pressure atomizing; ☐ vaporizing ______
Make and model ______ Control ______
Additional information: ______
Electric heating system: type ______ Input ______ watts, @ ______ volts, output ______ Btuh.
Additional information: ______
Ventilating equipment: attic fan, make and model ______, capacity ______ cfm.
kitchen exhaust fan, make and model Thermador
Other heating, ventilating, or cooling equipment 2 Bath fans Tradewind Model 1201

Figure 11-9. Specifications describe types of heating and cooling equipment requirements.

General Conditions

The methods of construction are included in the general conditions. See Figure 11-10. The general conditions, also referred to as general notes, describe the methods of construction that are not shown on the prints. For example, a typical condition might state "Provide two 2 × 12 headers over exterior openings except as noted."

The general conditions may also set forth the procedures for submitting change orders during the construction process. The rights and responsibilities of the builder and the owner are an important part of the general conditions.

Abbreviations

Construction materials and contract terms are abbreviated on standard specification forms and builder-developed specifications. See Figure 11-11. These abbreviations describe types of lumber, fixtures and other construction materials, and various general condition terms such as "revision" and "not in contract."

GENERAL CONDITIONS

The intent of the above specifications is to indicate the various materials, equipment and work to be installed in the building under this sale contract. This specification is intended to tell you what you are to receive in the completed construction of your new home. At the time that your home is completed, and just prior to your occupancy of same, your agent, yourselves, and a representative of the construction company will thoroughly examine the entire building and premises and list any items which need correcting. The Builder reserves the right to change manufacturers of certain products incorporated into construction of this home provided the design is similar and the quality equivalent.

It is understood and agreed between the parties that a contract to purchase the within described house is not a contract to custom build, but rather a contract to purchase a completed house with specification selections to be made by purchaser from allowances provided and prior to installation of same. Accordingly, the builder reserves and is granted the right to make minor changes in these plans and these brief specifications at his discretion. Any other changes must be agreed to in writing by both parties and additional cost, if any, is to be paid by purchaser to seller at time change is made. Seller will, at Seller's cost, supply purchaser with Home Owners Warranty policy. It is agreed and understood that all exterior paint colors, roof colors, brick and mortar color, shutter and trim colors, shall be subject to the approval of the subdivision Trustees prior to the installation, erection or application of same at the time the house is built and thereafter as long as the original trustees or their successors shall remain.

Approved:

____
Purchaser

____
Purchaser

OWNER AND BUILDER RESPONSIBILITIES

Figure 11-10. General conditions summarize the agreement between the builder and owner to prevent potential problems.

SPECIFICATION ABBREVIATIONS

Abbreviation	Term	Abbreviation	Term
ADD.	Addition	NIC	Not in contract
APPD or APVD	Approved	NOM	Nominal
ARCW	Arc weld	ORD	Ordinance
AT.	Airtight	PC	Piece
CONTR or CONT	Contract	PRMR	Primer
DF	Douglas fir	PROT	Protective
FRPF	Fireproof	RDM	Random
HDW	Hardware	REQD	Required
HDWD	Hardwood	REV	Revision
HNDRL	Handrail	RWD	Redwood
HNG	Hinge	SEL	Select
KD	Kiln-dried	SPEC	Specification
LBR	Lumber	WD	Wood
MFR or MFD	Manufacture	WP	White pine
MTD	Mounted	YP	Yellow pine
MTL or MATL	Material		

Figure 11-11. Abbreviations for materials and contract terms appear in the specifications.

REVIEW QUESTIONS

11

Specifications

Name ____________________ Date ____________

True-False

T F 1. Specifications cannot appear on a print with other parts of the drawing.

T F 2. Manufacturers' names commonly appear in the specifications.

T F 3. Divisions of information in the specifications are standard from builder to builder.

T F 4. CSI divisions are the most common for construction specifications.

T F 5. Specifications are helpful for estimation of building materials.

T F 6. Plywood with a grade of A/C has one face with an A grade and the other face with a C grade.

T F 7. The number of coats of paint for various areas of the building may be noted in the specifications.

T F 8. Specifications may contain a reference for electrical and plumbing work to be installed according to applicable building codes.

Multiple Choice

________ 1. Specifications are also called ___.
- A. details
- B. abbreviations
- C. specs
- D. fixtures

________ 2. Concrete is described in the specifications by the ___.
- A. size of the forms
- B. setting time
- C. number of sacks of cement
- D. type of footing

________ 3. The most common type of mortar for residential construction is ___.
- A. M
- B. N
- C. O
- D. S

_______________ 4. An allowance for a particular material is a ___.
   A. variance from acceptable construction practices
   B. dollar amount to be spent for this item
   C. weekly amount paid by the owner for construction
   D. none of the above

_______________ 5. Heating and cooling specifications may include information about ___.
   A. type of heating fuel
   B. ducting material
   C. manufacturers' names for equipment
   D. all of the above

Completion

_______________ 1. The two basic categories of lumber are ___ and ___.

_______________ 2. The two most common types of lumber for residential wood frame construction are ___ and ___.

_______________ 3. A test cylinder is used to measure the strength of ___.

_______________ 4. The rights and responsibilities of the owner and builder are detailed in the portion of the specifications called the ___.

Abbreviations

Provide the abbreviations for the following terms.

_______________ 1. Addition

_______________ 2. Contract

_______________ 3. Hardware

_______________ 4. Material

_______________ 5. Manufacturer

_______________ 6. Revision

_______________ 7. Specification

_______________ 8. Wood

Specifications

Refer to the specifications on pages 250 to 253 for questions 1 through 20.

T F 1. The fireplace flue is 1′ square.

T F 2. The exterior sheathing is ¾″ thick.

T F 3. The number of coats of paint is not specified.

T F 4. Exterior and interior doors are the same thickness.

T F 5. Wood stairways are not noted in the specifications.

T F 6. The house uses gas to fuel the water heater.

T F 7. Electrical wiring is placed in conduit.

T F 8. There is no landscaping allowance.

______________ 9. Steel reinforcement in the footing is ___″ in diameter.
- A. ⅛
- B. ¼
- C. ½
- D. 4

______________ 10. The roof is covered with ___.
- A. #15 wood shingles
- B. #240 asphalt shingles
- C. 26 ga zinc covering
- D. none of the above

______________ 11. The cabinet countertop is finished with ___.
- A. oak
- B. plastic laminate
- C. ceramic tile
- D. fir plywood

______________ 12. The kitchen sink ___.
- A. has two compartments
- B. is made of stainless steel
- C. has two drain boards
- D. all of the above

______________ 13. The 28-day strength requirements for the concrete foundation is ___ psi.

______________ 14. The owner will furnish three plumbing fixtures: the ___, ___, and ___.

______________ 15. Concrete at porches and terraces is ___″ thick.

______________ 16. The hearth is made of ___.

______________ 17. ___ sacks of cement are included in each cubic yard of concrete for the basement floor.

______________ 18. The grade and species of lumber used for exterior wall and floor framing is ___.

______________ 19. The material for screens is ___.

______________ 20. A total of ___ luminaires (lighting fixtures) are to be installed in the house.

FHA Form 2005
VA Form 26 1852

U S DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL HOUSING ADMINISTRATION

For accurate register of carbon copies, form may be separated along above fold Staple completed sheets together in original order

Form Approved
Budget Bureau No. 63-R0055

DESCRIPTION OF MATERIALS

No. ____________ (To be inserted by FHA or VA)

☐ Proposed Construction

☐ Under Construction

Property address ____________ City ____________ State ____________

Mortgagor or Sponsor ____________ (Name) ____________ (Address)

Contractor or Builder ____________ (Name) ____________ (Address)

INSTRUCTIONS

1 For additional information on how this form is to be submitted, number of copies, etc, see the instructions applicable to the FHA Application for Mortgage Insurance or VA Request for Determination of Reasonable Value, as the case may be

2 Describe all materials and equipment to be used, whether or not shown on the drawings, by marking an X in each appropriate check-box and entering the information called for in each space If space is inadequate, enter "See misc" and describe under item 27 or on an attached sheet

3 Work not specifically described or shown will not be considered unless required, then the minimum acceptable will be assumed Work exceeding minimum requirements cannot be considered unless specifically described

4 Include no alternates, "or equal" phrases, or contradictory items. (Consideration of a request for acceptance of substitute materials or equipment is not thereby precluded)

5 Include signatures required at the end of this form

6 The construction shall be completed in compliance with the related drawings and specifications, as amended during processing The specifications include this Description of Materials and the applicable Minimum Construction Requirements

1. EXCAVATION:

Bearing soil, type Clay, some sand, bearing capacity 2500 lb./ sq. ft.

2. FOUNDATIONS:

Footings concrete mix 5 bag mix, strength psi 2500 Reinforcing 2 - #4 bars

Foundation wall material Concrete masonry units Reinforcing horiz steel alt. courses

Interior foundation wall material n/a Party foundation wall n/a

Columns material and sizes 3½" std. pipe col. Piers material and reinforcing n/a

Girders material and sizes W 8 x 17 Sills material 2 x 6

Basement entrance areaway CMU Walls conc fl. Window areaways n/a

Waterproofing 1 coat pitch, polyethylene sheet Footing drains drain tile sump pump for basement

Termite protection chlordane soil treatment

Basementless space ground cover n/a, insulation n/a, foundation vents n/a

Special foundations stepped footings at R & L sides. Fireplace footing conc. 2 #5 bars 12'-0" lg.

Additional information Grade beam at garage entrance 2 #4 bars.

3. CHIMNEYS:

Material Face Brick & C.M.U. Prefabricated *(make and size)* n/a

Flue lining material Tile & vit. tile Heater flue size 8" vit. tile Fireplace flue size 12 x 12

Vents *(material and size)* gas or oil heater n/a, water heater n/a

Additional information Incinerator flue 12 x 12

4. FIREPLACES:

Type ☒ solid fuel, ☐ gas-burning, ☐ circulator *(make and size)* n/a Ash dump and clean-out 10 inch

Fireplace facing Face brick, lining Fire brick, hearth Q tile, mantel n/a

Additional information

5. EXTERIOR WALLS:

Wood frame: wood grade, and species #2 Pine ☐ Corner bracing. Building paper or felt 15# Felt

Sheathing fiberboard, thickness ½, width 4 x 8, ☐ solid, ☐ spaced n/a" o. c., ☐ diagonal, n/a

Siding boards & batten grade D select type n/a, size 1x8 1x2; exposure ____", fastening gal.case.nails

Shingles n/a, grade n/a; type n/a size n/a, exposure n/a"; fastening n/a

Stucco n/a, thickness n/a", Lath n/a, weight ____ lb.

Masonry veneer Face Brick Sills Face Brick Lintels St. angles Base flashing Al. sisalkraft

Masonry ☒ solid ☐ faced ☐ stuccoed, total wall thickness 8 x 12" facing thickness n/a", facing material n/a

Backup material n/a, thickness n/a bonding n/a

Door sills n/a Window sills n/a Lintels n/a Base flashing n/a

Interior surfaces dampproofing, n/a coats of n/a, furring n/a

Additional information

Exterior painting material Pigmented stain except doors, windows & frames oil paint; number of coats 2

Gable wall construction ☒ same as main walls, ☐ other construction

6. FLOOR FRAMING: 2 x 10 16" o.c. 2 x 10 12" o.c. under baths

Joists wood, grade, and species #2 Pine, other ____, bridging Steel cross, anchors metal

Concrete slab ☒ basement floor, ☐ first floor, ☒ ground supported, ☐ self-supporting, mix 6 bag mix, thickness 4",

reinforcing n/a, insulation n/a, membrane n/a

Fill under slab material crushed stone, thickness 4 Additional information

7. SUBFLOORING: *(Describe underflooring for special floors under item 21.)*

Material grade and species construction grade, size ½", type Plywood

Laid ☒ first floor, ☐ second floor, ☐ attic n/a sq. ft., ☐ diagonal, ☒ right angles. Additional information

Stagger joints and lay long way across joists. 1 x 2 furring 16" o.c.

8. FINISH FLOORING: *(Wood only. Describe other finish flooring under item 21.)*

Location	Rooms	Grade	Species	Thickness	Width	Bldg Paper	Finish
First floor	All	Underlay	n/a	5/8	n/a	n/a	
Second floor							
Attic floor	sq ft						

Additional information for carpeting or vinyl sheet goods

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VA Form 26-1852

DESCRIPTION OF MATERIALS

9. PARTITION FRAMING:
Studs wood, grade, and species #2 Pine size and spacing 2 x 4 16" o.c. Other n/a
Additional information n/a

10. CEILING FRAMING:
Joists wood, grade, and species #2 Pine 2 x 6 Other ______ Bridging Solid
Additional information ______

11. ROOF FRAMING:
Rafters wood, grade, and species #2 Pine 2 x 6 Roof trusses (see detail): grade and species ______
Additional information ______

12. ROOFING:
Sheathing wood, grade, and species Construction ½" Fir Plywood, ☒ solid, ☐ spaced n/a " o.c.
Roofing Asph. Shingles, grade 240#; size 3 tab; type Class C
Underlay Roofing Felt, weight or thickness 15#, size ______, fastening Zinc Ct.Nail
Built-up roofing n/a, number of plies n/a, surfacing material n/a
Flashing: material gal. st.; gage or weight 26 gage; ☐ gravel stops, ☐ snow guards
Additional information ______

13. GUTTERS AND DOWNSPOUTS:
Gutters material n/a, gage or weight n/a, size n/a, shape n/a
Downspouts material n/a, gage or weight n/a, size n/a, shape n/a, number n/a
Downspouts connected to: ☐ Storm sewer, ☐ sanitary sewer, ☐ dry-well. ☐ Splash blocks material and size ______
Additional information metal diverters at rear valley

14. LATH AND PLASTER
Lath ☐ walls, ☐ ceilings: material n/a, weight or thickness n/a Plaster coats n/a, finish n/a
Dry-wall ☒ walls, ☒ ceilings material gypsum bd., thickness ½; finish smooth
Joint treatment Tape & spackle, sand smooth

15. DECORATING: *(Paint, wallpaper, etc.)*

Rooms	Wall Finish Material and Application	Ceiling Finish Material and Application
Kitchen	Paint 3 coats	Paint 3 coats
Bath	Ceramic tile, Paint 3 coats above	Paint 3 coats
Other	Paint 3 coats	Paint 3 coats

Additional information ______

16. INTERIOR DOORS AND TRIM:
Doors type H.D. Flush & louvered material Flush Oak, Louvered Pine, thickness 1 3/8 - 1 3/4
Door trim type Solid, material oak Base type stock; material oak, size n/a
Finish doors Stain & varnish, trim stain & varnish
Other trim *(item, type and location)* mantel trim oak stain & varnish
Additional information ______

17. WINDOWS:
Windows type D.H.& casement, make Andersen, material Pine sash thickness 1 3/8
Glass grade Insulating, ☐ sash weights, ☐ balances, type Spring, head flashing n/a
Trim type Wood casing, material Oak Paint Stain & varnish; number coats 2
Weatherstripping type Friction, material st. st. Storm sash, number n/a
Screens ☒ full, ☐ half, type aluminum, number n/a, screen cloth material n/a
Basement windows type n/a, material n/a; screens, number n/a, Storm sash, number n/a
Special windows ______
Additional information ______

18. ENTRANCES AND EXTERIOR DETAIL:
Main entrance door material Pease Steel Clad, width 3'-0"; thickness 1 3/4" Frame material Pine, thickness 1 3/8"
Other entrance doors material Pease Steel Clad width 3'-0", thickness 1 3/4" Frame material Pine, thickness 1 3/8"
Head flashing n/a Weatherstripping type Friction, saddles n/a
Screen doors: thickness n/a ", number n/a, screen cloth material n/a Storm doors: thickness n/a ", number n/a
Combination storm and screen doors: thickness 1 1/8, number 2, screen cloth material Aluminum
Shutters ☐ hinged, ☐ fixed Railings Wood, Attic louvers 2 #2 Pine
Exterior millwork grade and species D Select (West Coast) Paint Pigmented stain, number coats 2
Additional information: Oil paint windows, doors, and trim

19. CABINETS AND INTERIOR DETAIL:
Kitchen cabinets, wall units material Oak, lineal feet of shelves 28', shelf width 12"
Base units material Oak, counter top Laminated plastic, edging Laminated plastic
Back and end splash Broderick 3309 Finish of cabinets ______, number coats ______
Medicine cabinets make ______, model ______
Other cabinets and built-in furniture ______
Additional information 2 Bathroom vanities Laminated plastic top Oak stain & varnish

20. STAIRS:

Stair	Treads		Risers		Strings		Handrail		Balusters	
	Material	Thickness	Material	Thickness	Material	Size	Material	Size	Material	Size
Basement	Conc.		Conc.		Conc.		Pipe	2"	n/a	
Main										
Attic										

Disappearing: make and model number Super Simplex folding stair (wood)
Additional information ______

21. SPECIAL FLOORS AND WAINSCOT:

	Location	Material, Color, Border, Sizes, Gage, Etc.	Threshold Material	Wall Base Material	Underfloor Material
Floors	Kitchen	Seamless vinyl--color by owner	Alum.	Wood	5/8" Part.bd.
	Bath	Seamless vinyl--color by owner	Alum.	Wood	5/8" Part.bd.

	Location	Material, Color, Border, Cap Sizes, Gage, Etc.	Height	Height Over Tub	Height in Showers (From Floor)
Wainscot	Bath	Ceramic tile, See Elevations	4'-2"	6'-4"	n/a

Bathroom accessories: [ ] Recessed; material ______, number ______, [X] Attached, material ceramic, number ______
Additional information: 2 Soap dish, 2 tumbler holder, 4 towel bar, 2 toilet paper holder

22. PLUMBING:

Fixture	Number	Location	Make	Mfr's Fixture Identification No.	Size	Color
Sink	1	Kitchen	Crane	St.St. 2 comp 2 drbd.	5' - 6"	S.S.
Lavatory	2	Bath	Crane	with vanity		as selected
Water closet	2	Bath	Crane	siphon jet with tank		as selected
Bathtub	2	Bath	Crane		5' - 0"	as selected
Shower over tub△	2	Bath	Crane			
Stall shower△	n/a					
Laundry trays	n/a					
Dishwasher		Kitchen	By Owner			
Disposal		Kitchen	Insinkerator	77	½ h.p.	
Washer Dryer		Closet	By Owner			

△[X] Curtain rod △[ ] Door [ ] Shower pan: material ______
Water supply: [X] public; [ ] community system; [ ] individual (private) system.★
Sewage disposal: [ ] public; [ ] community system; [X] individual (private) system.★
★*Show and describe individual system in complete detail in separate drawings and specifications according to requirements.*
House drain (inside): [X] cast iron; [ ] tile; [ ] other ______ House sewer (outside): [ ] cast iron; [X] tile; [ ] other ______
Water piping: [ ] galvanized steel; [X] copper tubing; [ ] other ______ Sill cocks, number ______
Domestic water heater: type Electric; make and model Rheem; heating capacity ______
______ gph. 100° rise. Storage tank: material Glass; capacity 55 gallons.
Gas service: [ ] utility company; [ ] liq. pet. gas; [ ] other ______ Gas piping: [ ] cooking; [ ] house heating.
Footing drains connected to: [ ] storm sewer; [ ] sanitary sewer; [ ] dry well. Sump pump; make and model ______
______; capacity ______; discharges into ______

23. HEATING:

[ ] Hot water. [ ] Steam. [ ] Vapor. [ ] One-pipe system. [ ] Two-pipe system.
[ ] Radiators. [ ] Convectors. [ ] Baseboard radiation. Make and model ______
Radiant panel: [ ] floor; [ ] wall; [ ] ceiling. Panel coil: material ______
[ ] Circulator. [ ] Return pump. Make and model ______; capacity ______ gpm.
Boiler: make and model ______ Output ______ Btuh.; net rating ______ Btuh.
Additional information: ______
Warm air: [ ] Gravity. [X] Forced. Type of system Ducts in basement
Duct material: supply Sheet metal; return sheet metal Insulation n/a, thickness n/a [ ] Outside air intake.
Furnace: make and model Lennox 09-105 Input ______ Btuh.; output 84,000 Btuh.
Additional information: ______
[ ] Space heater; [ ] floor furnace; [ ] wall heater. Input ______ Btuh.; output ______ Btuh.; number units ______
Make, model ______ Additional information: ______
Controls: make and types Johnson electric for above furnace
Additional information: ______
Fuel: [ ] Coal; [X] oil; [ ] gas; [ ] liq. pet. gas; [ ] electric; [ ] other ______; storage capacity 550 gal.
Additional information: ______
Firing equipment furnished separately: [ ] Gas burner, conversion type. [ ] Stoker: hopper feed [ ]; bin feed [ ]
Oil burner: [X] pressure atomizing; [ ] vaporizing ______
Make and model ______ Control ______
Additional information: ______
Electric heating system: type ______ Input ______ watts; @ ______ volts; output ______ Btuh.
Additional information: ______
Ventilating equipment: attic fan, make and model ______; capacity ______ cfm.
kitchen exhaust fan, make and model Thermador
Other heating, ventilating, or cooling equipment 2 Bath fans Tradewind Model 1201

24. ELECTRIC WIRING:

Service: [X] overhead; [ ] underground. Panel: [ ] fuse box; [X] circuit-breaker; make Bryant AMP's 200 No. circuits ______
Wiring: [X] conduit; [ ] armored cable; [ ] nonmetallic cable; [ ] knob and tube; [ ] other ______
Special outlets: [X] range; [X] water heater; [X] other oven, clothes dryer
[ ] Doorbell. [X] Chimes. Push-button locations Front & Back Doors Additional information: ______

25. LIGHTING FIXTURES:

Total number of fixtures 12 Total allowance for fixtures, typical installation, $ ______
Nontypical installation ______
Additional information: ______

DESCRIPTION OF MATERIALS

26. INSULATION:

Location	Thickness	Material, Type, and Method of Installation	Vapor Barrier
Roof	n/a		
Ceiling	6	foil faced fiberglass	
Wall	2"	foil faced fiberglass	
Floor	n/a		

HARDWARE: *(make, material, and finish.)* Schlage, bronze

SPECIAL EQUIPMENT: *(State material or make, model and quantity. Include only equipment and appliances which are acceptable by local law, custom and applicable FHA standards. Do not include items which, by established custom, are supplied by occupant and removed when he vacates premises or chattles prohibited by law from becoming realty.)*

Counter top range
Built-in oven
Garbage disposal

27. MISCELLANEOUS: *(Describe any main dwelling materials, equipment, or construction items not shown elsewhere; or use to provide additional information where the space provided was inadequate. Always reference by item number to correspond to numbering used on this form.)*

PORCHES: 4" concrete slab and covered porch at front door

TERRACES: 4" poured concrete slab with troweled finish

GARAGES:

WALKS AND DRIVEWAYS:

Driveway width n/a ; base material ______; thickness ____"; surfacing material ______; thickness ____"
Front walk: width n/a ; material ______, thickness ____". Service walk: width ____, material ______; thickness ____"
Steps: material n/a ; treads ____"; risers ____". Cheek walls ______

OTHER ONSITE IMPROVEMENTS:

(Specify all exterior onsite improvements not described elsewhere, including items such as unusual grading, drainage structures, retaining walls, fence, railings, and accessory structures.)

Entire site to be fine graded.

LANDSCAPING, PLANTING, AND FINISH GRADING:

Topsoil 4" thick. ☒ front yard; ☒ side yards; ☒ rear yard to 15 feet behind main building.
Lawns *(seeded, sodded, or sprigged)*: ☐ front yard n/a ; ☐ side yards ______; ☐ rear yard ______
Planting: ☐ as specified and shown on drawings; ☐ as follows:

n/a Shade trees, deciduous, ____" caliper.
n/a Low flowering trees, deciduous, ____' to ____'
n/a High-growing shrubs, deciduous, ____' to ____'
n/a Medium-growing shrubs, deciduous, ____' to ____'
n/a Low-growing shrubs, deciduous, ____' to ____'
n/a Evergreen trees, ____' to ____', B & B.
n/a Evergreen shrubs, ____' to ____', B & B.
____ Vines, 2-year ______

IDENTIFICATION.—This exhibit shall be identified by the signature of the builder, or sponsor, and/or the proposed mortgagor if the latter is known at the time of application.

Date ______ Signature ______

Signature ______

FHA Form 2005
VA Form 26-1852

Identification

Identify the panel identification information.

______________ 1. Panel grade

______________ 2. Product standard

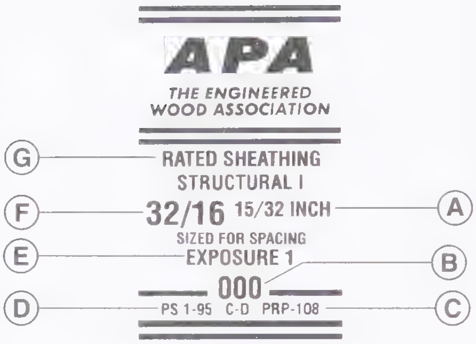
______________ 3. APA's performance rated panel

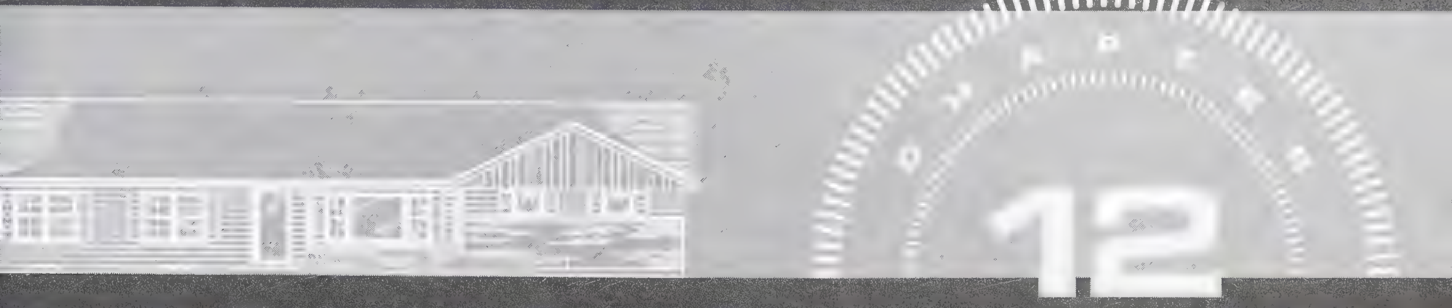
______________ 4. Exposure durability

______________ 5. Thickness

______________ 6. Mill number

______________ 7. Span rating





12 Relating Print Components

Residential printreading skills are acquired by studying prints and learning to interpret the drawing information. A skilled tradesworker visualizes the house and its components using the various drawing views contained in a set of prints. Tradesworkers reading the prints should imagine themselves inside the finished house based on the information shown on the prints. Visualization is important for properly planning, estimating, and constructing a house.

INTERRELATIONSHIP OF COMPONENTS

Information contained on all drawings and specifications is essential for proper house construction. To gain a comprehensive picture of the house, studying the complete set of drawings, including the plot plan, foundation plan, elevations, floor plan, details, and specifications, ensures that the house will be constructed per the design approved by the owner and architect. Visualizing and understanding the relationship of orthographic projections, sections, plan views, and details are essential printreading skills.

Views of components and construction materials must be consistent from one type of drawing to another. Because there may be conflicting information on the drawings, a tradesworker must carefully check the information regarding building components on various drawings before beginning construction. If information on one part of the print conflicts with information elsewhere, the architect should be consulted for clarification of the intended meaning. For example, if a cast-in-place concrete foundation wall is shown on the foundation plan, and a concrete masonry unit foundation is shown in the specifications, the architect must resolve the discrepancy.

DIMENSIONING AND REPRESENTATION

The tradesworker must be familiar with the methods architects use to create prints. Knowledge of dimensioning, scaling, and drawing lines is necessary to read plan dimensions accurately and interpret drawing representations properly. Abbreviations and symbols must be translated correctly in order to install the building components and construction materials shown on the drawings.

Scale

Residential prints depict items that are much larger than the sizes shown on paper. Scaled drawings show the dimensions and sizes of building components and their proper locations and proportions in relation to each other. Dimensions are expressed on residential prints in feet, inches, and fractions of an inch, or feet and tenths and hundredths of a foot.

Lines

Various line types are used in residential prints. Object lines and hidden lines are used to show building components and materials. Centerlines, dimension lines, and extension lines are used to locate and provide size information about components and materials. Section lines are used on objects that have been "sliced" to show additional detail. Leader lines bring attention to objects and relate information about the objects.

Abbreviations

An abbreviation may have different meanings when used on different drawings in a set of prints. When a tradesworker interprets abbreviations, the portion of the drawing being viewed and the type of building component or material being described must be considered. For example, the abbreviation "PL" indicates "plate" when referring to a pane of glass on an elevation and "property line" when showing the edge of the building lot on a plot plan.

Symbols

Construction materials are not always described in notations on residential prints. Standard symbols represent materials that are used in residential construction. Types of wood, concrete, and masonry, for example, are shown with symbols. Electrical, plumbing, and heating and air conditioning materials are also shown with symbols.

Other symbols and identification codes on residential drawings refer to schedules that provide additional information about building components and electrical, plumbing, and heating and air conditioning equipment.

The Garnett plans (included in the Prints Folder) are referred to in the discussion on pages 256 to 278. Refer to the plans while reading along.

PROJECT OVERVIEW

The Garnett plans included in the Prints Folder are comprised of six sheets. The first five sheets contain architectural drawings numbered 1 through 5. The sixth sheet is the electrical plan, which is labeled as E-1. Sheet 1 contains the site (plot) plan and the left side, right side, rear, and front exterior elevations. Sheet 2 contains the foundation plan. Sheet 3 contains the floor plan. Sheet 4 includes interior elevations, a recessed light detail, site structure details for items such as the mail box, and a detail of the master bedroom bathing area. Sheet 5 contains several sections and elevations, the roof plan, and several details for items such as the mantle, shoe racks, windows, and plant shelves.

Before reviewing the specific items on each page in detail, the entire set of prints should be reviewed to gain an overview of the building. The various views of the building and its components are easier to visualize after a general review of the overall structure.

John Deere Construction & Forestry Company

A plot plan is used by operating engineers performing excavation work.

Title Block

The title block on sheet 1 shows that the plans were drawn by Larry W. Garnett and Associates Building Designers, located in Pasadena, Texas. The plans were completed on July 8 by an architect with the initials LBG. The job identification number given by the architect is D-187N.

PLOT PLAN

A plot plan is also known as a site plan. The lot shown on sheet 1 is located in the subdivision or development called "Hills of Lakeway," and the house is located in block 7. The number inside the property lines shows that this house is built on lot number 92 of this development on a street named Lakeway Road. The site plan is drawn at the scale 1″ = 20′-0″. The subdivision plat plan used by the surveyor and developer shows the exact location of the lot and block.

Property Lines

The property lines are indicated with dashed lines around the perimeter of the drawing. See Figure 12-1. All property line lengths are expressed in feet and tenths and hundredths of a foot. The lot is basically pie shaped, with only a small portion accessible to the street. The front of the lot at the street has a straight section that is 18.11′ long and a curved section that is 26.82′ long. The right side property line is 149.36′ long and is the longest straight property line on the lot. The rear property line is 95.82′ long, with an offset section 24.05′ long. The left property line is 113.98′ long.

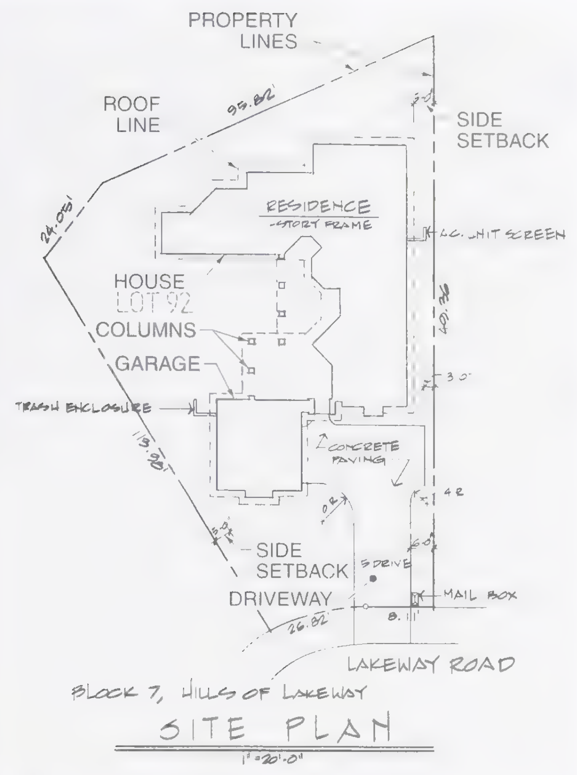


Figure 12-1. The site plan is a scaled drawing that shows the shape and size of the building lot and the location, shape, and overall size of the house on the lot.

Building Location

Two dimension lines from the property line at the right of the print show that the house is 5′-0″ from and parallel to the property line. A 5′-0″ side setback is also noted along the left property line.

Building Information

The site plan provides information about the driveway, house, and the general locations of several other items including the mail box, trash enclosure, and air conditioner unit screen. Additional details of some of these items are included on sheet 4.

Driveway. The driveway is 15′-0″ wide from the street to a large turnaround area with two curved areas located in front of the house. The driveway is located 6′-0″ from the property line at the right of the site plan. The turnaround area is built to within 3′-0″ of the right property line. The radius of the right curve is 4′-0″ and the radius of the left curve is 10′-0″. A notation indicates a concrete driveway. The object line outline of the driveway shows an entry walkway to the front of the house. The large driveway access to the house area at the left indicates a side entry garage. The building to the left of the house outline is the garage.

House. The house outline shows a structure with many offsets. The roof lines (shown with hidden lines) indicate the roof overhang. The object lines inside the roof lines show the exterior walls of the house at ground level, excluding any cantilevered portions. The house outline and roof line indicate that the roof is continuous even though the garage walls are not connected to the house walls. Columns shown with object lines are located behind the garage to support the roof over an open area.

Other Structures. Other building items shown on the site plan include a mail box, trash enclosure, and an air conditioner screen. The mail box is located on the front property line to the right of the driveway. The trash enclosure is located at the left rear of the garage. The air conditioner screen is along the right side of the house. Details on sheet 4 provide additional building information about these building items.

EXTERIOR ELEVATIONS

Sheet 1 also includes all four exterior elevations. The titles of the elevations are shown below the drawings. All exterior elevations are drawn at a ¼″ = 1′-0″ scale. The floor plan (sheet 3) should be cross-referenced for room names and door and window locations.

Left Side Elevation

The front of the house is along the right side of the left side elevation. Portions of bedroom 3, the master bedroom, the breakfast room, arbor, entry, loggia, and garage are included on the left side elevation. The highest ridge line represents the ridge board for the house. The vertical object line farthest to the left is the cantilevered window in bedroom 2. The first offset at the left is bedroom 3. The ceiling height in bedroom 3 is 10′-0″ and the two windows in this bedroom are shown.

The next offset is the master bedroom. The top of the master bedroom fireplace flue is 24″ above the ridge line of the master bedroom. The stucco trim on this flue extends 24″ below the decorative cap. A horizontal line at the bottom left of the master bedroom fireplace flue indicates a cricket.

The next two offsets are the master bath and closet. The decorative pilasters on the two outside corners of the closet are shown.

The roof is covered with mission tile roofing. All roofs on the house are built at a 7 on 12 pitch (as shown on the front elevation).

The center of the left side elevation provides an orthographic view of the arbor and loggia. Columns and arches support the flat arbor roof. The windows and doors under the arbor are (from left to right) the two breakfast room windows, the double French doors from the entry, three entry windows in the angular wall, and the main entry doors with the semicircular panel above. The elevated roof section over the flat arbor roof shows the roof offset around the breakfast room and entry. Sections 1 and 2 are noted as appearing on sheet 5 of the prints. These sections are noted with arrows indicating 1/5 and 2/5.

A note in the front arch of the loggia indicates that the arches in the arbor and loggia area are to be constructed to a 24″ radius and centered between the columns.

The living room fireplace flue is shown above the ridge line of the loggia. The flue is finished on the outside with a horizontal row of 8″ square ceramic tile between 4″ wide stucco trim sections. A 2 × 12 fascia with a 1 × 6 trim board is applied above the tile and stucco. The flue is capped with lightweight concrete sloped away from the flue. An additional detail regarding the stucco trim, which is 24″ below the flue trim, is shown elsewhere.

The left side of the garage and the front garage window are shown on the left side elevation. The trash enclosure shown on the site plan as being on the left side garage wall is not shown. The relief line in the stucco siding on the garage is 6′-0″ above the floor. The top wall plate height is 8′-0″ in the garage and 9′-0″ for the garage window offset. The ends of the rafters are finished with a 2 × 12 fascia with a 1 × 6 trim board.

Right Side Elevation

The front of the house is along the left side of the right side elevation. The first item at the left with a 9′-0″ high plate line is the front garage window offset. The garage ceiling height is 8′-0″. Decorative pilasters on the right side of the garage window offset and garage wall are shown along with the overhead panel door. The horizontal line to the right of the garage roof is the ridge line of the loggia roof.

The living room fireplace flue at the front of the house obscures the front entry on the right side elevation. The portion of roof shown behind the fireplace flue is the roof over the loggia entry. The lower horizontal line indicates a cricket behind the fireplace flue.

The main section of the house is shown on the remainder of the right side elevation. The finished ceiling height in the main section of the house is 10′-0″. The decorative pilaster on the right front corner of the living room is to the right of the fireplace flue. The two high, narrow windows are located in the dining room. The shorter window toward the rear of the house is installed over the kitchen sink. The window at the rear is the large cantilevered window in bedroom 2. More information on the cantilevered window is included in section 4 on sheet 5.

Architectural notations on the right side elevation indicate the type of roofing material and the roof slope. The methods of application and type of stucco siding on the exterior walls must be verified with the building contractor. The relief line in the siding material is 6′-8″ above the floor. Cutting planes for sections 1 and 2 (included on sheet 5) are shown on the right side elevation. The air conditioner screen shown on the site plan is not shown.

French doors are swinging doors with panes of glass that constitute nearly all the surface area of the doors.

Rear Elevation

Five offsets are shown on the rear elevation. Bedrooms 2 and 3 are in the first offset from the left. The finished ceiling height in bedrooms 2 and 3 is 10′-0″. The large cantilevered window in the rear corner of bedroom 2 is shown on the rear elevation and with section 4 on sheet 5. The height to the top of the windows and the relief line in the stucco exterior finish is 6′-8″ above the floor.

The roof line drops in the next offset, which is the master bedroom. Two windows in the rear of the master bedroom are shown at the same height as the lower windows in bedroom 2. An architectural notation on the roof over the master bedroom indicates that the entire roof is covered with mission tile and built to a 7 on 12 pitch. The top of the flue for the master bedroom fireplace is 2′-0″ above the ridge line of the master bedroom.

The next three offsets are the angular wall in the linen area and the master bedroom closet wall. The angular roof over the angular wall is shown. The ceiling height in this area is lowered to 8′-0″. The relief line in the stucco exterior finish along this area is 6′-0″ above the floor. The design on the pilaster on the rear corner of the closet is shown. The cutting plane for section 3 through the linen/bathing area is indicated on the rear elevation.

Portland Cement Association

A vapor barrier is typically placed under a concrete slab-on-grade to prevent migration of groundwater up through the slab.

Front Elevation

The front elevation shows the house using orthographic projection from the street side of the lot. Dimensions at either side of the drawing indicate three different wall heights in the house. The garage walls at the left of the drawing have an 8′-0″ plate height. The front window offset in the garage has 9′-0″ walls. The main section of the house to the right of the drawing is 10′-0″ high to the finished ceiling.

A notation on the front of the garage indicates that the exterior walls are covered with stucco siding. The stucco is formed with a relief line at the top of the wall. Relief lines are 6′-8″ high on 10′-0″ walls and 6′-0″ high on the 8′-0″ and 9′-0″ walls. The contractor will provide additional information about the type of plaster and the final finish.

From left to right, the windows and doors shown are the front garage window, the front doors, and two windows in the living room on the sides of the fireplace flue. The front doors are a pair of six-panel doors with an arched panel above. The three windows on the front of the house have a 3′-3″ radius arched section at the top, which is typical of all arched windows in the house. The sizes and types of the doors and windows are indicated on the floor plan.

The roof pitch shown on the front elevation is a 7″ unit rise per 12″ unit run. The roof is a hip roof covered with mission tile roofing. The overhang is finished with a 2 × 12 fascia board. A 1 × 6 trim board is attached to the top edge of the 2 × 12. No gutter is shown on the elevation.

The exterior of the fireplace flue is covered with the same stucco siding as the exterior walls. The relief line is higher than on the walls, 24″ below the top of the flue trim. A 4″ stucco trim member is applied above and below a row of 8″ square ceramic tile. A 2 × 12 and 1 × 6 are fastened around the top of the flue in the same manner as at the ends of the rafters at the overhang. The top of the fireplace flue is finished with lightweight concrete sloped down toward the edges of the flue.

FOUNDATION PLAN

Sheet 2 contains the foundation plan for the house. The foundation plan shows the type of foundation system and includes the overall dimensions of the foundation and offsets. The front of the house is along the right side of the foundation plan. The foundation plan is drawn at a 90° angle to the orientation of the house on the site plan. The patio is along the bottom of the foundation plan. The foundation plan is drawn at a ¼″ = 1′-0″ scale. The title block provides no additional information about the drawing that has not already appeared on sheet 1.

Fill material below a slab-on-grade must be free of vegetation and foreign material.

Type of Foundation

An architectural notation in the center of the sheet indicates that the foundation is a 4″ concrete slab-on-grade. The slab is reinforced with welded wire reinforcement composed of #6 wire spaced in a 6″ by 6″ grid. The concrete is placed over a 6 mil thick plastic polyethylene vapor barrier. Sand is used as a fill material below the polyethylene vapor barrier.

Footings. Hidden lines represent footing locations and widths around the perimeter of the house and throughout the slab. Extension, dimension, and centerlines around the perimeter of the drawing indicate locations of the footings. Footings are to be 1′-4″ wide as shown along the patio, which is typical throughout the slab.

Foundation Dimensions

The overall dimensions of the foundation are 64′-4″ (side to side) by 93′-0″ (front to back). Two 2′-0″ offsets along the right of the drawing are for the garage window and fireplace, which are shown on the front elevation. The opening for the overhead door is 16′-0″ wide.

A recessed area in the slab is shown in the lower-left corner of the foundation plan. This octagonal area is located 4″ from the front edge of the foundation slab and 6′-1″ from the edge of the patio and is 9′-8″ wide across the flats (2′-10″ + 4′-0″ + 2′-10″ = 9′-8″). The floor slab in this area is recessed 6″ below the rest of the floor. A floor drain is indicated in the floor slab. The height of the bottom of the recessed octagon must be above the natural grade of the building lot.

Other Information

Semicircular symbols are shown at five locations on the foundation plan, with each of the symbols occurring at an object line. The symbols and object lines indicate offsets in the slab height. See Figure 12-2. The patio area is built below the house floor level to allow for runoff of rainwater. The thicker area of the semicircle indicates the higher elevation of the slab, and the narrower end indicates the lower slab. The foundation is higher at each side of the front door entrance appearing on the right side of the print. In addition, one of these symbols in the garage area indicates that the perimeter of the garage floor slab is raised on three sides.

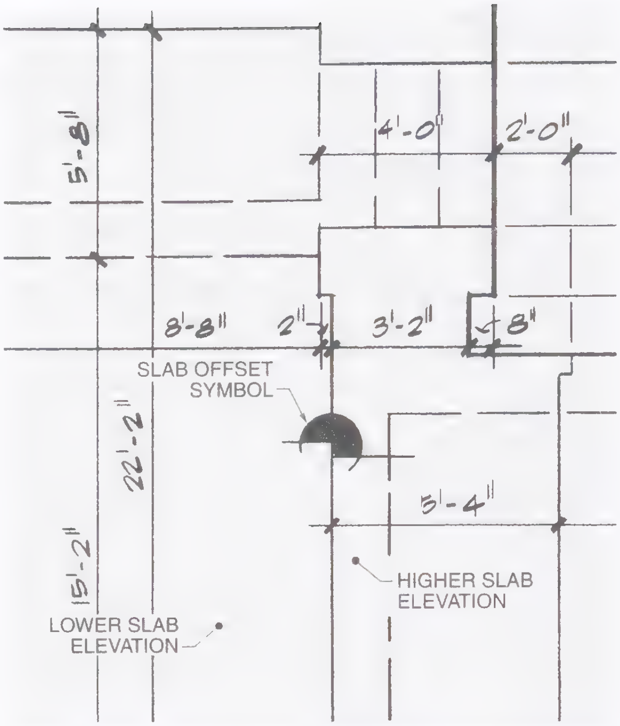


Figure 12-2. The slab offset symbol indicates a change in elevation of the slab.

Architectural notations describe the patio slab and the garage floor slope. The garage floor is sloped toward the driveway. The patio is sloped away from the house slab.

FLOOR PLAN

Sheet 3 contains the floor plan. The floor plan is oriented on the sheet in the same direction as the foundation plan. Drawing symbols indicate that the house is constructed with wood framing members. Walls are framed with 2 × 4 studs and plates. The actual dimensions of a 2 × 4 are 1½″ thick by 3½″ wide.

A chart below the garage floor plan indicates the overall area of the living areas and the entire slab (in square feet). Additional notations indicate that the dimensions shown on the floor plan are to the face of the studs. Walls are framed to these dimensions, and deductions are made in the interior room sizes for wall finish materials. Another notation states that window headers are all placed at the same height (6′-8″) unless otherwise specified. Hidden lines on the floor plan indicate the roof overhang.

The rooms of the house and the garage are named, and the movement pattern through the house can be determined. Facing the front of the house, a two-car

garage is to the left of the front door. The entry through the front door shown on the front elevation leads into a covered porch area called the loggia. A swinging door from the garage also opens onto the loggia. The loggia and arbor are adjoining outdoor areas with a roof supported by columns.

The front entry door of the house is at a 45° angle to the front wall of the house. The entry opens onto the loggia, living room, dining room, and arbor. A central hallway toward the center of the house leads to the kitchen, breakfast room, wet bar, bathroom, and three bedrooms. The master bedroom is built in a separate wing from the main house and has an entrance onto the arbor. The master bath and closet are at the farthest end of the house.

Garage

The exterior dimensions of the garage are 24′-0″ × 22′-0″. Vehicle entry into the garage is made through a 16′-0″ × 7′-0″ sectional overhead door. The overhead door is located 2′-2″ from the front corner of the garage. The header for the overhead door is constructed with 2 × 12s with a piece of ¾″ plywood fastened between them. A 2′-8″ left-hand swinging door in the rear wall of the garage is provided for access to the loggia.

One of the arched windows shown on the front elevation is located in the center of a 7′-0″ wide by 2′-0″ deep offset at the front of the garage. The front elevation shows that the walls of the offset are 9′-0″ high. The window is a 3′-0″ × 5′-0″ single-hung, double-light window with a 3′-0″ arched window above the main window. The top of this window is 6′-0″ high as noted.

The interior of the garage walls and ceiling are finished with gypsum board (drywall). As shown on the front elevation, the garage walls are 8′-0″ high. A section of the rear garage wall shown with a hidden line is extended to a height of 10′-0″ to match the height of the front wall of the house. The roof plan provides more detail about the garage roof. The ceiling is framed with 2 × 10s spaced 16″ OC, which run parallel with the front of the house.

As shown on the foundation plan, the concrete slab in the garage has an offset. A 4″ offset is built around three sides of the slab to form a wheel stop around the sunken floor in the middle of the garage.

The outside corners of the garage are finished with 1′-4″ wide pilasters that are similar to pilasters on other outside corners of the house. Facing the house from the front, a hose bibb is located on the left side of the garage.

In areas with cold climates, a freezeproof hose bibb is installed for outdoor applications. The valve of a freezeproof hose bibb, located within the valve assembly, is inside the building to prevent the hose bibb from freezing.

Loggia and Arbor

A pair of 2′-0″ wide swinging doors open onto the loggia near the overhead door. The edge of the loggia is 8′-2″ from the left side of the garage. The ceiling over the loggia is constructed with 2 × 8 ceiling joists spaced 16″ OC and running parallel with the side of the house. Beams are placed around the perimeter of the loggia on the columns. The ceiling and roof are supported by 1′-4″ square wood columns. Centerlines of the columns are 7′-10″ and 7′-6″ behind the garage.

The arbor behind the loggia is another open-air living area. The ceiling of the arbor is mostly open and is framed with 2 × 12s (indicated by centerlines) spaced 24″ OC and running parallel with the front of the house. The ceiling joists are supported by two double 2 × 12 beams at the same height as the fascia. Metal joist hangers support the ceiling joists where they butt against the beams. The 2 × 12 ceiling joists have 2 × 2s fastened to them at 6″ OC, forming a trellis. The arbor ceiling is supported by 1′-4″ square wood columns in a similar manner as the columns in the loggia.

The arrows indicating sections 1 and 5 extend through the arbor. Further details of the arbor are included on sections 1 and 2 on sheet 5.

Entry

The door leading into the foyer is a double 2′-8″ French door with an arched transom above. Two 5′-8″ dimensions indicate that the entry is built at a 45° angle to the other walls in the house.

The right side of the entry is open, leading into the living room beyond a 2′-4″ long wall. The left side of the entry is constructed with three 2′-8″ × 6′-0″ single-hung, double-light windows. The windows each have a 2′-8″ × 1′-6″ fixed-glass, double-light window above. The windows are separated by 6″ wide posts. The overall dimension of the left entry wall is 10′-10″.

Another section of entry wall parallel with the side walls is located behind the windows. This wall has two 3′-0″ wide French doors that open to the arbor. A 6′-0″ × 1′-6″ high fixed-glass, double-light window is located above the French doors.

The ceiling in the entry is constructed of 2 × 6s spaced 16″ OC and running parallel with the entry door wall. The ceiling joists are supported by a beam over the opening between the entry and living room. Walls in the entry are 10′-0″ high. The concrete floor slab is finished with tile.

Living Room

The interior of the living room is 18′-9″ wide (after deducting for the thickness of two 2 × 4 walls totaling 7″) by 17′-6½″ deep (after deducting for the thickness of one 2 × 4 wall). The front wall of the living room has a metal fireplace with a 36″ opening centered between two windows. See Figure 12-3. The offset for the fireplace is 5′-0″ × 2′-0″. The hearth is tile, which is installed flush with the floor level. A gas outlet is located in the fireplace offset for log lighting or gas logs. The window on each side of the fireplace is centered 3′-0″ from the fireplace offset. The windows are 3′-0″ × 6′-0″ single-hung, double-light with a 3′-0″ arch above. The windows are also shown on the front elevation.

The wall between the living room and the loggia contains a 9′-2½″ long media cabinet (11′-0″ − 1′-6″ − 3½″ = 9′-2½″). The opposite wall of the living room does not contain any window or door openings. The living room ceiling is 10′-0″ high and is framed with 2 × 10s spaced 16″ OC and running parallel with the front wall. The finish floor material is carpet.

Dining Room

The dining room is separated from the living room and the entry by plant shelves, which are shown with hidden lines. Each plant shelf around the dining room rests on two 1′-4″ columns. The bottoms of the plant shelves are 6′-8″ above the floor. The shelves are framed with 2 × 12s. The outside wall of the dining room has two windows, each 1′-8″ to center from the inside of the dining room walls. The windows are 2′-0″ × 6′-0″, single-hung, double-light windows with a 2′-0″ × 1′-6″ fixed-glass, double-light window above.

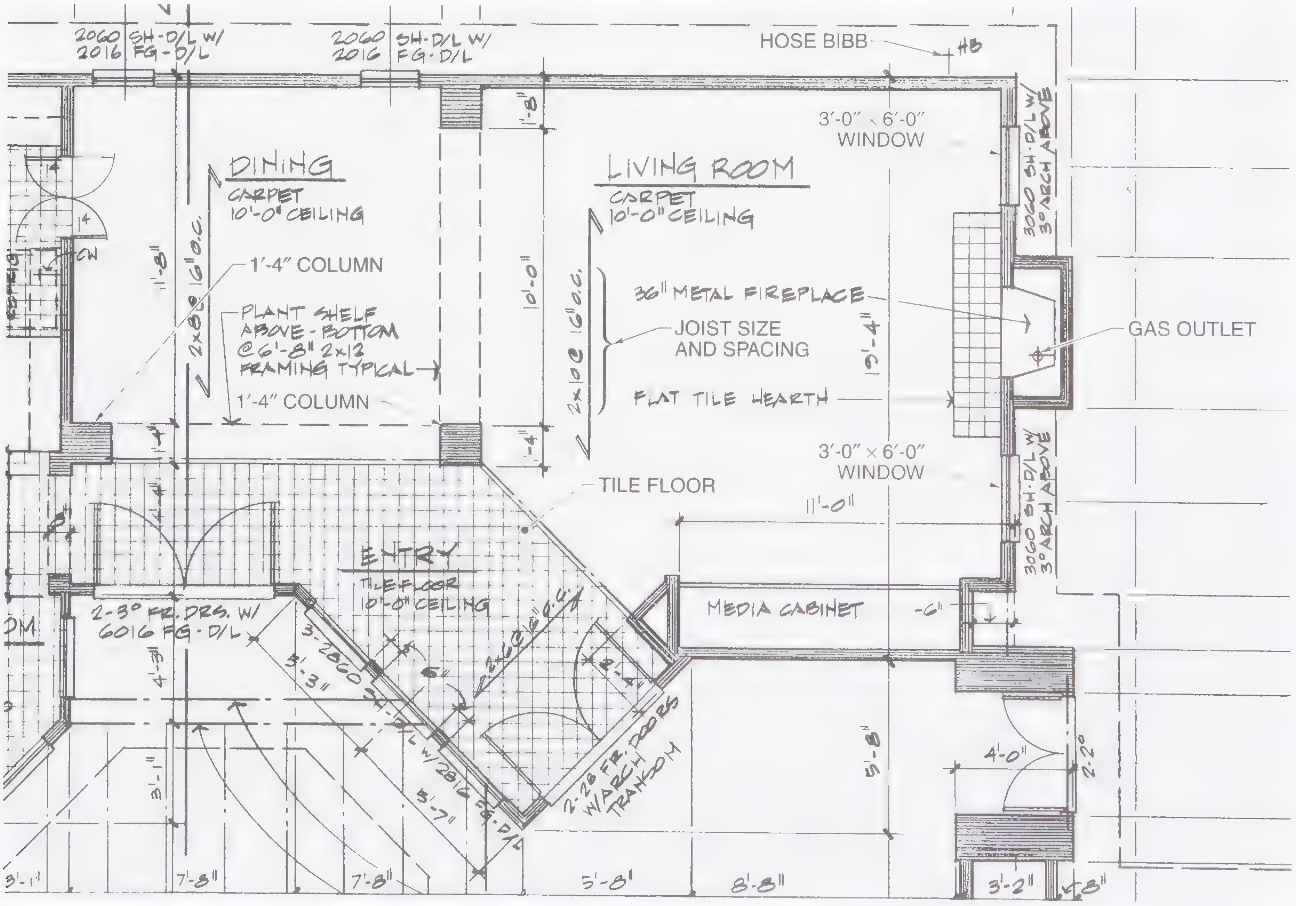


Figure 12-3. The floor plan is a scaled drawing of a house looking directly down from a horizontal cutting plane taken 5′-0″ above the finished floor.

The wall between the dining room and kitchen has two 1′-4″ wide double-acting swinging doors. The dining room ceiling is 10′-0″ high and is framed with 2 × 8s spaced 16″ OC and running parallel with the front wall. The finish floor material is carpet. Section 2 on sheet 5 provides additional information about the dining room.

Kitchen

The kitchen is open to the breakfast room above a 42″ high cabinet countertop. Jenn-Air® is the brand name of the electric countertop range. Ovens and the required gas outlets are also shown on the rear wall of the kitchen. Hidden lines indicate wall cabinets above the cabinets on the rear kitchen wall.

A 4′-1″ wide pantry (inside dimension) is located in the back corner of the kitchen with shelves along the rear and outside walls. The wall with the pantry door is at a 45° angle to the exterior walls. A 2′-0″ wide left-hand swinging door is installed in the pantry. Swinging door information is described by the type of door ordered for the required installation. For example, the pantry door shown as a right-hand reverse swinging door on the plans is ordered as a left-hand swinging door from the supplier. This practice is not followed when a door requires two different face finishes.

A double-bowl sink and dishwasher are located on the exterior kitchen wall. The dishwasher is represented with hidden lines. A 3′-0″ × 3′-0″, single-hung, double-light window with a 3′-0″ × 1′-6″ fixed-glass, double-light window above is located in the wall over the kitchen sink. The center of the window is 2′-1″ from the pantry wall and 6′-5¼″ from the kitchen side of the kitchen/dining room wall. Wall cabinets hung above the dishwasher and edges of the base cabinet are shown with hidden lines.

The refrigerator is placed against the wall between the kitchen and dining room. A cold water supply is indicated for connection of the refrigerator icemaker. Base cabinets are installed next to the refrigerator and are shown with object lines. Hidden lines represent the wall cabinets over the refrigerator and base cabinets.

The kitchen ceiling is 10′-0″ high. The ceiling joists are 2 × 8s spaced 16″ OC and running parallel with the side walls of the house. The floor is finished with tile. The cutting plane for section 1 on sheet 5 extends through the kitchen.

Breakfast Room

The kitchen and entry both open into the breakfast room. The opening between the entry and breakfast room is 3′-4″ wide with an 8″ wide header above, which is shown with hidden lines. The exterior breakfast room walls are laid out in a partial octagon. The angle formed at the intersection of these walls forms a 22½° angle. The four exterior breakfast room walls each have a 2′-8″ × 6′-0″ single-hung, double-light window, with a 2′-8″ × 1′-6″ fixed-glass, double-light window above.

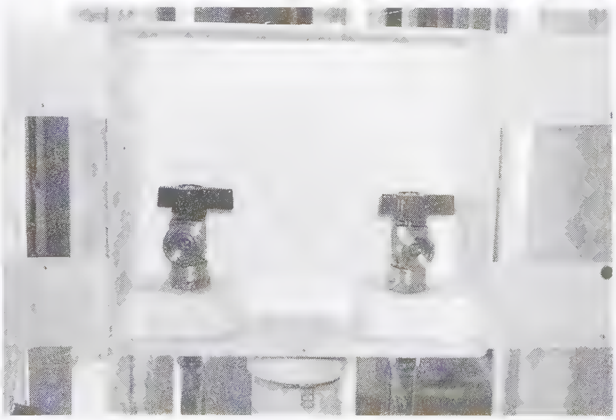
The ceiling in the breakfast room is 10′-0″ high and is framed with 2 × 8s spaced 16″ OC and running parallel with the front wall of the house. The finished flooring material is tile. The cutting plane for section 1 extends through the breakfast room. Section 1 is included on sheet 5.

Wet Bar

The wet bar is entered from the hallway through a 2′-0″ opening that has a header above. Base cabinets are located on three walls in the wet bar area with a sink in the angular corner. A wall cabinet is installed on the wall between the wet bar and the master bedroom. Bifold shutters open from the wet bar into the breakfast room. A 2′-8″ × 3′-8″ single-hung, double-light window with a 2′-8″ × 1′-6″ fixed-glass, double-light window above is to be installed over the sink of the wet bar. The floor finish and ceiling height are the same as the kitchen and breakfast room.

Utility Room

The utility room is located toward the rear of the house. The clothes dryer and washing machine are installed in the utility room. A set of 5′-0″ wide bifold doors provides access to the utility room. A gas connection for the dryer is shown on the rear wall of the utility room. Hot and cold water supplies in the rear wall of the utility room are provided for the washing machine.



A clothes washer outlet box is a plastic enclosure that accommodates water supply and waste connections for a clothes washer.

Bedrooms 2 and 3

Bedrooms 2 and 3 are located at the rear of the house. In both bedrooms, the ceiling is 10′-0″ high and the finish flooring material is carpet. The ceiling joists in both bedrooms are 2 × 6s spaced 16″ OC and running parallel with the rear wall of the house. Each of the bedrooms is entered through a 2′-8″ wide right-hand swinging door.

Bedroom 2. Bedroom 2 has direct entry into bath 2 through a 2′-0″ wide, left-hand swinging door. A 3′-0½″ deep walk-in closet is shown between bedroom 2 and bath 2. The walk-in closet is entered through a 2′-0″ wide right-hand swinging door. Shelves are installed on both sides of the closet but not in the rear.

The rear corner of bedroom 2 has an offset section with several windows. A 4 × 4 post supports two double 2 × 12 headers. The headers provide structural support for the corner of the roof. Projections that are 1′-3″ deep by 6′-0″ long are constructed out from the right side and rear walls. Each projection has an 8″ long wall section in the middle. On each side of these narrow wall sections, 2′-0″ × 5′-0″ single-hung, double-light windows with 2′-0″ × 1′-6″, fixed-glass, double-light windows above are installed. The area inside the offset is finished with an 18″ high window seat. The cutting plane extending through the window area indicates that further construction information is included on section 4 on sheet 5.

Sioux Chief Manufacturing Company, Inc.

A water hammer arrestor may be installed on a water supply pipe to reduce the effects of water hammer. Water hammer is a water supply system defect in which a loud noise is created when a quick-closing valve is suddenly closed.

Bedroom 3. The smallest bedroom in the house is bedroom 3. The interior dimensions of bedroom 3 are 10′-5″ × 11′-4½″. A 3′-8½″ deep walk-in closet is provided in bedroom 3, with a 2′-0″ wide left-hand swinging door. Closet shelves are located on the walls between the closet and the master bedroom and the display area. No shelves are installed on the wall behind the utility room. Two 2′-8″ × 6′-0″ single-hung, double-light windows are installed in the left wall of bedroom 3.

Bath 2

Bath 2 is entered from bedroom 2 and the hallway through 2′-0″ wide, left-hand swinging doors. A set of linen shelves is provided just inside the door from bedroom 2. A double-bowl vanity is installed on the wall between bath 2 and the kitchen. The vanity area of bath 2 is finished with carpet and separated from the bathing area with a 2′-0″ wide, right-hand swinging door.

The water closet and bathtub plumbing is installed in the wall between bath 2 and the kitchen, with the bathtub against the outside wall. The floor in the bathing area is finished with vinyl tile.

A small linen closet is to be constructed in the hallway outside of bath 2. Access to the closet is provided through a 2′-0″ wide, right-hand swinging door. A set of disappearing stairs (indicated with hidden lines) is installed in the hallway ceiling outside of bath 2 to provide entry into the attic. Disappearing stairs are suspended in the ceiling opening with a system of springs and lowered into place by unfolding several short hinged stair sections.

Double 2 × 12 headers are supported by 4 × 4 posts in bedroom 2. A ½″ plywood spacer is commonly placed between the 2 × 12s.

Master Bedroom

A short hallway between the wet bar and utility room provides access to the master bedroom. A display shelf is located in this hallway to the right of the master bedroom entry door. The door leading into the master bedroom from the hallway is a double 2′-0″ swinging door. A 2′-8″ wide, right-hand French door opens between the master bedroom and the arbor.

The dimensions of the master bedroom are 20′-9″ × 17′-0½″ (21′-4″ − [2 × 3½″ wall thickness] = 20′-9″; 17′-4″ − 3½″ wall thickness = 17′-0½″). The floor of the master bedroom is finished with carpet and has a 9′-0″ high ceiling framed with 2 × 8s spaced 16″ OC and

running parallel with the rear of the house. The master bedroom has four windows. The rear house wall has two 2′-8″ × 6′-0″ single-hung, double-light windows. Two 2′-8″ × 5′-0″ single-hung, double-light windows are to be installed in the exterior walls between the master bedroom and the arbor. The window in the angular wall is installed 1″ off center.

The master bedroom is separated from the bathing area by a raised tile hearth, cabinets, and a two-way fireplace. The fireplace has a 36″ wide opening and is open on two sides to allow the fire to be seen from the master bedroom and the bathing area. A gas connection in the fireplace area is provided for a log lighter or gas logs. Cabinets are open in the master bedroom on the arbor side of the fireplace. A television/videotape recorder cabinet area is built in an opening on the rear side of the fireplace.

Master Bath. A passageway in the master bedroom goes through a linen area into the master bath. See Figure 12-4. An 8″ thick wall separates these two areas, with a header above the opening. The linen area is 7′-0″ long with linen shelves on both sides. The ceiling is constructed with 2 × 6s spaced 16″ OC and running parallel to the side walls. The linen area ceiling is 8′-0″ high.

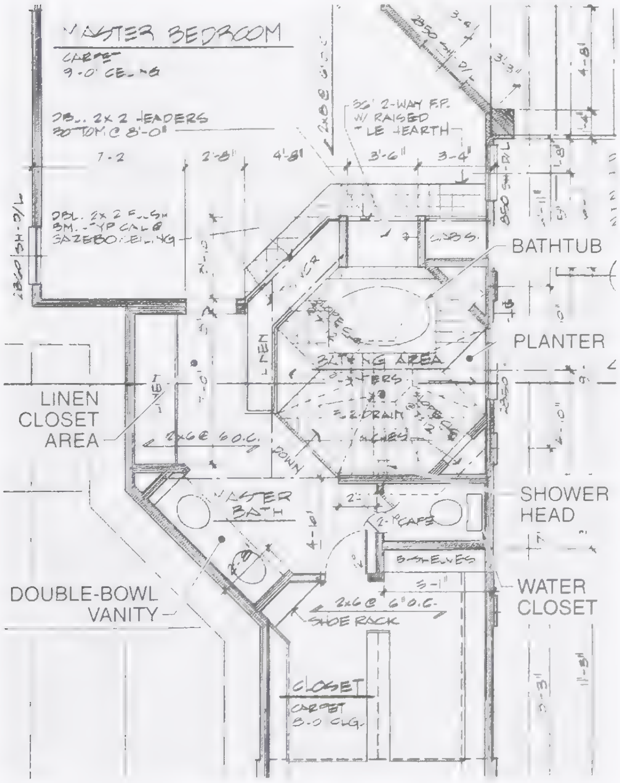


Figure 12-4. A passageway through the linen area between the master bath and master bedroom provides access to the master bath, bathing area, and water closet.

A double-bowl vanity is located on the angular wall at the rear of the master bath. The water closet is installed on the master bath wall toward the front of the house. The master bath water closet area is separated from the rest of the room by a pair of 1′-0″ wide, double-acting swinging cafe doors. The water closet area is 2′-9″ × 4′-9½″. Hidden lines on the wall between the water closet area and bathing area indicate a furred-down ceiling for a planter shelf in the bathing area.

As shown on sheet E-1, three recessed luminaires are installed in the furred-down area in the bathing area.

Bathing Area. As indicated on the floor plan, the floor of the bathing area is one step down from the master bath. The 6″ recessed octagonal slab area shown on the foundation plan is for the bathing area. The bathing area recessed floor is finished with tile. The bathing area contains a bathtub on the side near the fireplace and a built-in shower on the side near the master bath. A floor drain is located slightly off center of the bathing area toward the master bath. Hot and cold water faucets are installed in the wall between the bathing area and the master bath.

Triangular planters are located on two opposite sides of the bathing area toward the front and back of the house. Recessed niches are built in the walls on either side of the planter toward the front of the house.

Broken lines over the fireplace indicate a double 2 × 12 beam located 8′-0″ above the floor. This beam continues around the bathing area into the short wall section dividing the master bedroom and master bath linen area. The beam at the rear of the bathing area through the linen area joins with another beam parallel with the side wall of the master bath.

The ceiling framing in the bathing area is detailed with architectural notations and hidden lines. The hidden lines over the bathing area indicate an octagonal ceiling with a 7″ unit rise on a 12″ unit run up toward the center. A level octagonal area is at the top center of the bathing area.

A 2′-8″ × 5′-0″ single-hung, double-light window is installed in the front wall of the bathing area over the planter. This window is centered in the front wall of the bathing area.

A hose bibb is provided on the exterior wall of the bathing area to the right of the window. Two exterior pilasters are shown on the exterior wall of the bathing area and are positioned 7′-7″ OC.

Two additional drawings of the bathing area are included in the set of prints. The cutting plane for section 3 extends through the bathing and linen areas. An enlarged plan view of the bathing area is also included on sheet 4.

Closet. The master bedroom closet is entered through a 2′-0″ wide, right-hand swinging door. A shoe rack is installed to the right of the door and five shelves installed to the left. Shelves are installed around the remaining perimeter of the closet, with an additional shelf in the center of the room parallel with the front wall. The ceiling is 8′-0″ high with 2×6 ceiling joists spaced 16″ OC and running parallel with the side wall. The floor is finished with carpet.

Three decorative pilasters are to be constructed along the exterior wall of the closet. Two pilasters are along the outside corners of the closet and one additional flat pilaster is located 8′-3″ to center from the outside corner of the closet. The extension line at the outside corner originates at the corner of the framing, not the outside of the pilasters.

INTERIOR ELEVATIONS

Sheet 4 contains interior elevations, including interior views of the dining room, living room, kitchen, wet bar, utility room, bath 2, master bedroom and bath, and bathing area. The interior elevations are drawn at a ¼″ = 1′-0″ scale.

Dining Room

The interior elevation of the dining room at the left is shown as though the viewer is looking from the rear of the house toward the front, which is the view from the dining room into the living room. The designs of the open plant shelf and the column and pilaster between the two rooms are shown.

The dining room elevation at the right is shown as though the viewer is looking out of the dining room toward the arbor/entry area. Windows in the angular entry wall are at the left of the drawing. The double French doors opening from the hallway to the arbor appear at the right. The design of the open plant shelf and the column and pilaster between the dining room and the entry hallway are shown.

Four recessed luminaires are installed above the plant shelves on two sides of the dining room.

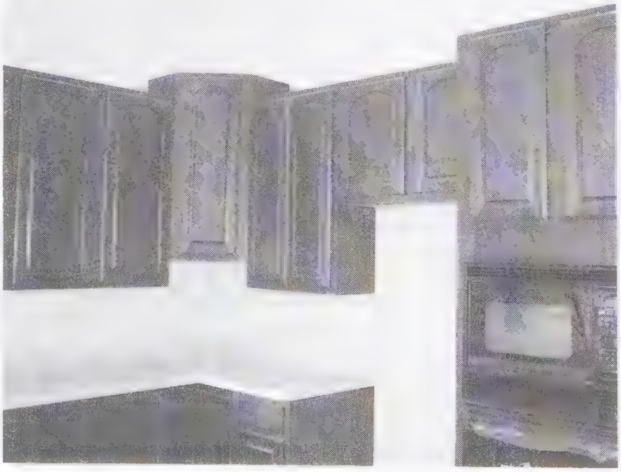
Living Room

One interior elevation of the living room is provided to show the style of the built-in media cabinet on the wall between the living room and the loggia. The cabinet is 96″ tall with a 24″ open shelf over the top. Six pairs of swinging cabinet doors are indicated on the elevation by the handle locations—three pairs above and three pairs below. The cabinet doors are constructed with raised panels. An arch with raised panels is constructed flush to the bottom of the ceiling in the area above the cabinet.

Kitchen

The interior elevation of the kitchen at the left shows the cabinet arrangement between the pantry and dining room wall along the exterior wall. The kitchen ceiling is 10′-0″ high. The sink cabinet is installed below the window. A dishwasher is installed next to the sink with a 36″ high base cabinet between the dishwasher and the dining room wall. Two 52″ high wall cabinets are fastened to the wall above the dishwasher and base cabinet with an open shelf area above. The open areas between the base and wall cabinets and above the wall cabinets are 16″ high.

The second interior elevation of the kitchen shows the cabinet arrangement on the wall between the kitchen and the dining room looking from the back of the house toward the front. A 32″ high wall cabinet is installed 72″ above the floor to provide room for a refrigerator. Two base and wall cabinets are set between the refrigerator area and the entry hallway wall. A 16″ high open shelf is provided over the wall cabinets. The open areas at the right are in the entry hallway.



Kitchen wall cabinets are installed at the heights shown on interior elevations.

A view from the front of the kitchen toward the back of the house is shown on the third interior elevation of the kitchen. This interior elevation shows an end view of the breakfast bar cabinet in the breakfast area with a 42″ high countertop. Three wall cabinets and three base cabinets are installed in a design that provides room for the built-in ovens. The exact size of the opening for the ovens depends on the manufacturer and type of ovens. An open shelf is provided over the wall cabinets.

The interior elevation of the kitchen at the right shows the view out of the kitchen into the breakfast room. A cooktop is installed in the breakfast bar cabinet between the kitchen and the breakfast room. Two small cabinets are installed on either side of the cooktop cabinet. An outline of the wall and base cabinets at the right of this elevation indicates the profile of the wall cabinets.

Wet Bar

Two interior elevations of the wet bar are provided. The left elevation is the view from the wet bar into the breakfast room looking from the back of the house toward the front. The corner pantry sink is shown at an angle because of the angular wall in the wet bar. Shutters between the wet bar and the breakfast room are installed above several base cabinets. The window at the right opens into the arbor.

The second interior elevation at the right indicates cabinet heights. This interior elevation is the view from the wet bar toward the master bedroom. Base cabinets are 36″ high and wall cabinets are 52″ high. A 16″ high open shelf is provided over the top of the wall cabinets and a 16″ space remains between the wall and base cabinets after installation.

Utility

The interior elevation of the utility area shows two 44″ high wall cabinets installed 52″ above the floor. A 24″ open space is provided above the cabinets. The area below the wall cabinets is designed as a space for the washer and dryer.

Bath 2

The cabinet arrangement on the wall between bath 2 and the kitchen is shown at the left of the interior elevation of bath 2. Three 32″ high base cabinets are installed, with the smaller center cabinet having one drawer.

A double-bowl sink is installed in the base cabinet of bath 2. A 36″ × 72″ mirror is installed on the wall 6″ above the top of the double-bowl vanity. The wall is furred-out 46″ above the top of the backsplash. The height of the furred-out area is 12″, resulting in a 24″ high plant shelf above.

A second interior elevation of bath 2 details the linen cabinet inside the door leading from bedroom 2. This cabinet has three sets of swinging doors and is 7′-0″ high. The area above the cabinet is open for additional shelf space.

Built-in ovens are self-contained appliances that are installed in a kitchen cabinet.

Master Bedroom

The interior elevation of the master bedroom provides a view from the master bedroom toward the closet end of the bedroom offset. The central item in the elevation is the open fireplace between the master bedroom and the bathing area. A mantle and raised panel are installed above the open fireplace to the 12″ furred-down area at the supporting double 2 × 12 beam. The furred-down area finishes 84″ above the hearth. Two recessed lights installed in the furred-down area are shown with hidden lines on both sides of the fireplace. The fireplace rests on a tile hearth elevated 12″ above the floor line.

Cabinets are installed on both sides of the fireplace. The top of the cabinets is 80″ above the floor line. The area between the top of the cabinets and furred-down area is open into the bathing area. The open area shown to the right of the fireplace cabinets is the door leading into the master bath linen area.

Cement board is used as the tile base in the bathing area because of the high humidity level.

Master Bath. Three interior elevations are provided for the master bath area. The elevation at the left shows the linen cabinets along the rear wall. The cabinets are 80″ high with an open shelf area above. There are three cabinets, each with six doors and four drawers.

The center elevation shows the linen cabinets installed on the wall between the master bath linen area and the bathing area. The design of the two cabinets is similar to the design of the linen cabinets against the rear wall. Hidden lines above the floor line indicate the planter. Hidden lines below the floor line indicate the recessed 6″ floor slab in the bathing area.

The elevation at the right shows the double-bowl vanity along the rear angular wall. Three 32″ high base cabinets are installed, with the center cabinet having one door and one drawer. A 6″ gap is provided between the top of the vanity and the mirror. The mirror above the vanity is 36″ high by 78″ wide. The ceiling is furred-down 12″ over the master bath vanity to finish 52″ above the top of the vanity.

Bathing Area. The bathing area in the master bedroom is one of the most complicated areas of construction in the house. Three interior elevations, an enlarged floor plan, and a section are provided to fully describe the bathing area.

The interior elevation of the bathing area at the left is shown as though the viewer is looking from the front of the house toward the back. The open area at the left shows the entry from the linen area. The wall is 80″ high with a 16″ high plant shelf above. The floor slab in the bathing area is 6″ below the main floor. Cabinets at the right of this elevation are at the rear of the bathing area, separating it from the linen area.

In a flat plane, three sets of three doors are shown. Other cabinets between the bathing area and master bedroom are shown on an angle. These cabinets have a total of six doors. The area above these cabinets is open to the linen area and master bedroom. The sloped ceiling is shown with a series of horizontal lines. The irregular floor design in this area illustrates a built-in bathtub below the cabinets. The open fireplace is shown to the right of the bathtub. The design of the raised hearth in the master bedroom is shown on the opposite side of the fireplace opening. A 6″ offset is stepped out an additional 6″ to create a 12″ high hearth. The fireplace opening is 6″ above the hearth.

The center elevation of the bathing area is shown as though the viewer is looking from the rear of the house toward the front. The window in the center of the elevation is installed between the bathing area and the arbor. The wall above the window is finished with wallpaper. Walls in the bathing area are finished with tile. Niches are built into the walls on both sides of the window. Niches are 26″ above the floor and 44″ high. The floor section shows that the two steps up to the tub are each 9″ high.

The third elevation of the bathing area appears as though the viewer is looking from the bathtub wall toward the closet end of the house with the front of the house to the left. The exterior window wall appears at the left of the elevation, with one niche shown. A 22″ high plant shelf is constructed below the window. The open area at the right of the elevation is the entry into the bathing area from the linen area. The 80″ high linen cabinets are outlined, with a 16″ opening above. A 22″ high plant shelf is also provided on the bathing area side of the linen cabinets.

ENLARGED PLAN OF BATHING AREA

An enlarged plan view of the bathing area is also included on sheet 4. The enlarged plan view is drawn at a ⅜″ = 1′-0″ scale. Most of the information about the finish materials and floor and ceiling heights in the bathing area is included on the enlarged plan view. Hidden lines in the water closet area indicate a plant shelf. The plant shelf is built 6′-8″ above the floor level and is 12″ deep. Hidden line arcs extending from the faces of the cabinets indicate the door hand for the cabinet doors. Hot and cold water faucets for the shower are installed at the master bath side of the bathing area.

General note 3 at the lower right of the enlarged plan view states that elevations are noted in relation to the slab height of 0″. Elevations of 0″ are shown on the master bedroom side of the hearth at the top of the drawing and the linen area floor at the left. The 6″ step down into the bathing area is noted as –6″. A line through the center of the octagonal floor area from the point of one planter to the other shows a 9″ step up in the floor to elevation +3″. This first step is narrow, leading to two areas at the front and rear of the bathtub at an elevation of +12″, another 9″ step up. The fireplace is raised another 6″ to an elevation of +18″. The hearth on the master bedroom side of the open fireplace is 12″ above the main floor slab height.

Architectural notations provide additional information about the bathing area. The stereo cabinet installed toward the front of the house opens into the master bedroom area. Tempered glass enclosure doors are installed on both sides of the open fireplace between the master bedroom and bathing area.

The bathtub is 60″ long, 42″ wide, and 18″ deep. Two niches, one on each side of the bathing area window, are built 24″ wide, 44″ high, and 12″ deep and are finished with tile. A notation describes the television/video cassette recorder cabinet between the master bedroom and bathing area. The television is mounted on a pullout revolving cabinet. No electrical switches are accessible from the bathing area side of this cabinet because water is present in this area. Two triangular planters at the front and rear of the bathing area are built to a height approximately 4″ above the top of the bathtub. The floor drain in the bathing area is slightly off center toward the master bath. The ceiling in the bathing area is framed in an octagonal pattern that slopes at a 7 on 12 (7:12) pitch up to a horizontal level area in the center. Hidden lines show the corners of the ceiling and the 10′-0″ high center octagon. The hidden line in the master bath area indicates a plant shelf that is closed on the master bath side as a soffit and open into the bathing area.

Carrier Corporation

An air conditioner condenser is one component of a forced-air air conditioning system.

The floor drain in the bathing area has an integral trap to prevent sewer gases from entering the living area.

Three general notes are included. Tile is installed on the bathing area walls to a height of 6′-8″. The portion of the walls above the tile is finished with wallpaper. All cabinets in the bathing area are constructed to a maximum height of 6′-8″. All elevation dimensions on the enlarged plan view are taken from a benchmark of 0″—the floor height of the main house.

SITE STRUCTURES DETAILS

Three structures shown on the site plan that do not appear on the elevations or floor plan are the mail box, air conditioner condenser unit screen, and trash enclosure. Additional details are included on sheet 4 of the prints to describe these structures. All of the details are drawn at a ¼″ = 1′-0″ scale.

Mail Box

The mail box is 2′-4″ wide along the front property line and extends 3′-0″ deep into the lot. The mail box is 5′-0″ tall, excluding the roof, which has a 7 on 12 pitch. The door of a metal mail box is shown on the front elevation, indicating that the metal mail box is set into the mail box structure. The mail box structure is covered with stucco siding. Stucco trim is applied above and below a row of 6″ ceramic tile. The stucco and tile area is capped with a wood 1 × 8 fascia that is covered at the top with a 1 × 4 trim board. The roof is covered with Spanish mission (clay) tile.

Air Conditioner Condenser Unit Screen

The air conditioner condenser unit screen shown on the site plan is on the right side of the house. A plan view of the screen indicates it is 5′-0″ wide and 5′-0″ deep. See Figure 12-5. The right side elevation shows the screen height is 4′-0″. The air conditioner unit rests on a 4″ thick concrete pad. Three 6 × 6 wood corner posts rest on a 2 × 6 treated sill. A 2 × 8 top rail above the 6 × 6 posts is capped with a 2 × 6 that is painted to match the house. This framework supports 1 × 6s installed at an angle to allow for airflow around the air conditioning condenser unit. The plan view represents the 1 × 6 screening with diagonal lines. Object lines on the right side elevation show the screening installed vertically.

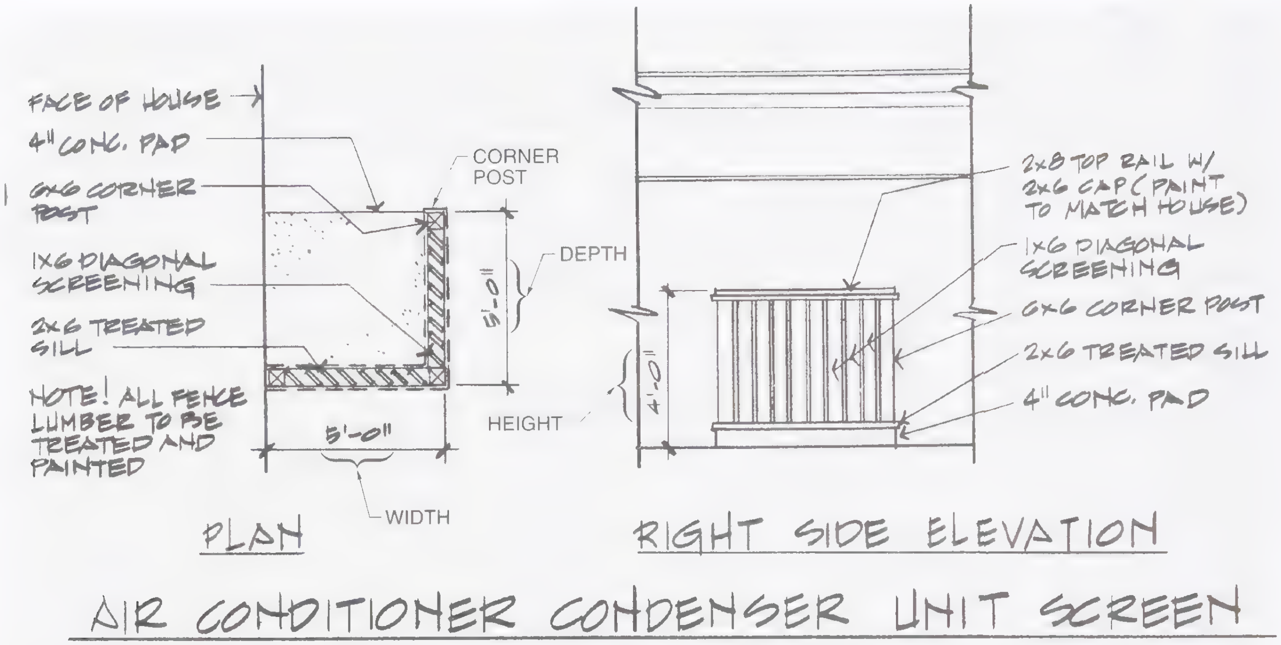


Figure 12-5. The air conditioner condenser unit screen conceals the air conditioner condenser.

Trash Enclosure

The trash enclosure is shown at the left rear of the garage area on the site plan. The elevations indicate that the trash enclosure is 6′-0″ wide by 4′-0″ deep. The walls of the trash enclosure are 6′-0″ high and finished with stucco siding to match the exterior of the house. The inside floor area of the trash enclosure is a concrete pad. The roof shown is the roof of the side and rear garage area.

RECESSED LIGHT DETAIL

The kitchen is lit with a recessed fluorescent luminaire (lighting fixture) that is drawn at a 1″ = 1′-0″ scale. A double ceiling joist is framed around the opening. Ceiling joists are attached to the double joist with metal joist hangers for additional structural support. Horizontal 2 × 4s are framed on top of the ceiling joists and finished on the bottom with ½″ gypsum board that is painted white. The inside of the double ceiling joist is also finished with gypsum board. The fluorescent luminaire is installed below the gypsum board on the 2 × 4s. A 1 × 4 is covered on both edges by wood trim (manufacturer number CM9). The inside trim member supports a lens installed beneath the fluorescent luminaires.

Lumber treated with ammoniacal copper arsenate (ACA) must be used for residential construction. ACA-treated lumber is approved by the Environmental Protection Agency.

SECTIONS

Numbers at the ends of cutting planes on the elevations and floor plan, such as 1/5, 2/5, 3/5, and 4/5, indicate the section numbers and their locations. The first number indicates the section number and the second number indicates the sheet of the prints on which the section appears. All of the sections for this set of prints appear on sheet 5. All section are drawn to a ¼″ = 1′-0″ scale.

Section 1—Section/Courtyard Elevation

The cutting plane for section 1 is shown on the floor plan and the right and left side elevations. The cutting plane extends through the kitchen, breakfast room, and arbor. Arrows at the ends of the cutting plane indicate a view from the rear of the house toward the front. From this view, the right side of the house appears at the left of the drawing.

The attached connections for recessed luminaires are enclosed behind the finished ceiling surface.

The kitchen is at the left of section 1. The exterior wall is "sliced" to show the headers at the kitchen window. The sink cabinet and wall cabinets are installed against the exterior wall. The double door into the dining room is shown to the right of the exterior wall cabinets. Wall cabinets are installed above the refrigerator area and base cabinets are installed to the right of the refrigerator.

The design of the roof framing and bracing over the kitchen and breakfast room is also shown. The roof pitch is 7 on 12. Rafters are braced with horizontal collar ties. Angular braces support the rafters at the ends of the collar ties and bear on the kitchen/entry wall. A double ceiling joist is installed for additional roof support. The soffit area at the ends of the rafters is closed. Soffit finish is supported by horizontal blocking between the wall and fascia board.

Open areas between the kitchen/breakfast room and the entry are shown. The windows shown are installed in the breakfast room. The section through the wall behind the breakfast room shows the framing above and below the windows. The step down from the house to the arbor that was indicated on the foundation plan is shown at the breakfast room wall.

The arbor is covered with a slatted roof. Columns, beams, joists, and slats are seen on section 1. The six-panel swinging door provides access from the rear of the garage into the loggia. There is one more step at the columns from the arbor floor level to the loggia floor. An arch for the rear of the loggia roof is shown with a 24″ radius arch centered between the columns. The garage has a finished ceiling height of 8′-0″ and is shown at the right of the drawing.

Section 2—Section/Courtyard Elevation

The cutting plane for section 2 extends through the arbor, entry, and dining room. This section appears as though the viewer is looking at the house from the front toward the back. The right side walls are on the right of the section.

The master bedroom closet and bathing area are shown at the left of the section. The outside corner pilaster and three flat pilasters on the exterior of this area are also shown. The first window from the left is the window in the bathing area. The next two windows to the right are the windows in the master bedroom. The master bedroom door providing access to the arbor is next on the right. The two windows farthest to the right are located in the wet bar area. The master bedroom fireplace flue is shown. The cutting plane for section 3 is located in the bathing area.

Additional description of the arbor roof is provided on section 2. Joists are 2 × 12s spaced 24″ OC and are supported by metal joist hangers at each end. The beam supported by the columns is a double 2 × 12 finished similar to the ends of the rafters with a 1 × 12 fascia and a 1 × 6 trim board. The trellis roof is constructed with 2 × 2s spaced 6″ OC. The angular lines on the columns indicate that the tops of the columns are sloped to prevent rainwater and other moisture from accumulating and to minimize decay of the columns from moisture penetration.

The main house roof is cantilevered 5′-0″ over the doors from the entry to the arbor. An additional 2 × 12 header is framed to support the roof load. More support for the cantilevered area is provided by a short wall section constructed above the exterior entry wall. Collar ties and angular braces provide additional structural support for the main roof. Ceiling joists over this area are 2 × 8s spaced 16″ OC.

Open areas inside the entry show the entry into the breakfast room. Pilasters and the plant shelf between the entry and dining room are detailed. The pilaster is 6′-8″ high. The size of the opening above the shelf is 1′-4″ (plus or minus). The furring from the ceiling, which is framed with 2 × 12s, projects down 12″ (plus or minus).

Collar ties are horizontal members connecting two opposite rafters. Collar ties are typically installed on every second or third pair of rafters.

The ceiling height in the dining room is 10′-0″. The door between the dining room and kitchen is shown. The relief line in the exterior finish is 6′-8″ above the floor. The object line flush with the soffit trim members is the cantilevered window in bedroom 2.

Section 3

The cutting plane for section 3 is shown on the floor plan, rear elevation, and section/courtyard elevation 2. The cutting plane for section 3 extends through the bathing area with the view toward the master bedroom. The linen area top plate height is 8′-0″. The linen closet with drawers and shelves is shown at the left of the door opening into the master bedroom. Additional cabinets between the linen closet and the bathing area do not have shelves. The bathing area side of the television/video cassette recorder cabinet appears to the left side of the open fireplace. The niche to the right of the fireplace and the window framing are both shown at the right of the section. Open areas are shown above the cabinets on the master bedroom side of the bathing area.

Roof framing over the bathing area is detailed. A double 2 × 12 header supports 2 × 8 rafters spaced 16″ OC. The center section of the bathing area ceiling is finished 10′-0″ above the house floor height, not including the 6″ recessed slab in the bathing area floor. Section 3 also shows an orthographic projection of the steps into the bathtub and the planter areas at either side of the steps.

The roof pitch of all the roofs on the house is 7 on 12, which means that for every 7″ of unit rise there is 12″ of unit run.

Section 4

Framing for the cantilevered windows at the rear corner of bedroom 2 is detailed on section 4. The location for this cutting plane is shown on the floor plan, rear elevation, and right side elevation. This section views the framing as though the viewer is looking from the front of the house toward the rear.

A short wood-framed wall is constructed from the floor to the bottom of the horizontal window seat framing. The top of the horizontal window seat is 18″ above the floor level with the finish window seat installed. A short wall section is framed below the windows. A double header is constructed between the lower and upper windows. A double plate is built above the upper window. A double header at the wall line supports the rafters. The ceiling height in bedroom 2 is 10′-0″. Bedroom 2 windows installed in the rear wall are also shown.

SOFFIT DETAIL

The soffit detail on sheet 5 shows the soffit and roof framing and exterior wall finish. See Figure 12-6. The soffit detail is drawn at a 1½″ = 1′-0″ scale.

Roof Information

The roof is covered with Spanish mission (clay) tile roofing installed over 30 lb felt building paper covering ¾″ plywood roof sheathing. Rafters and ceiling joists are 2 × 8s spaced at a minimum of 16″ OC. The ends of the rafters project 1′-8″ from the face of the studs. The ceiling is insulated with 6¼″ thick batts to provide a rating of R-19. A 1″ minimum open air space is provided between the bottom of the roof sheathing and the insulation for ventilation of the attic space.

The ends of the rafters, commonly referred to as rafter tails, project 1′-8″ from the face of the studs.

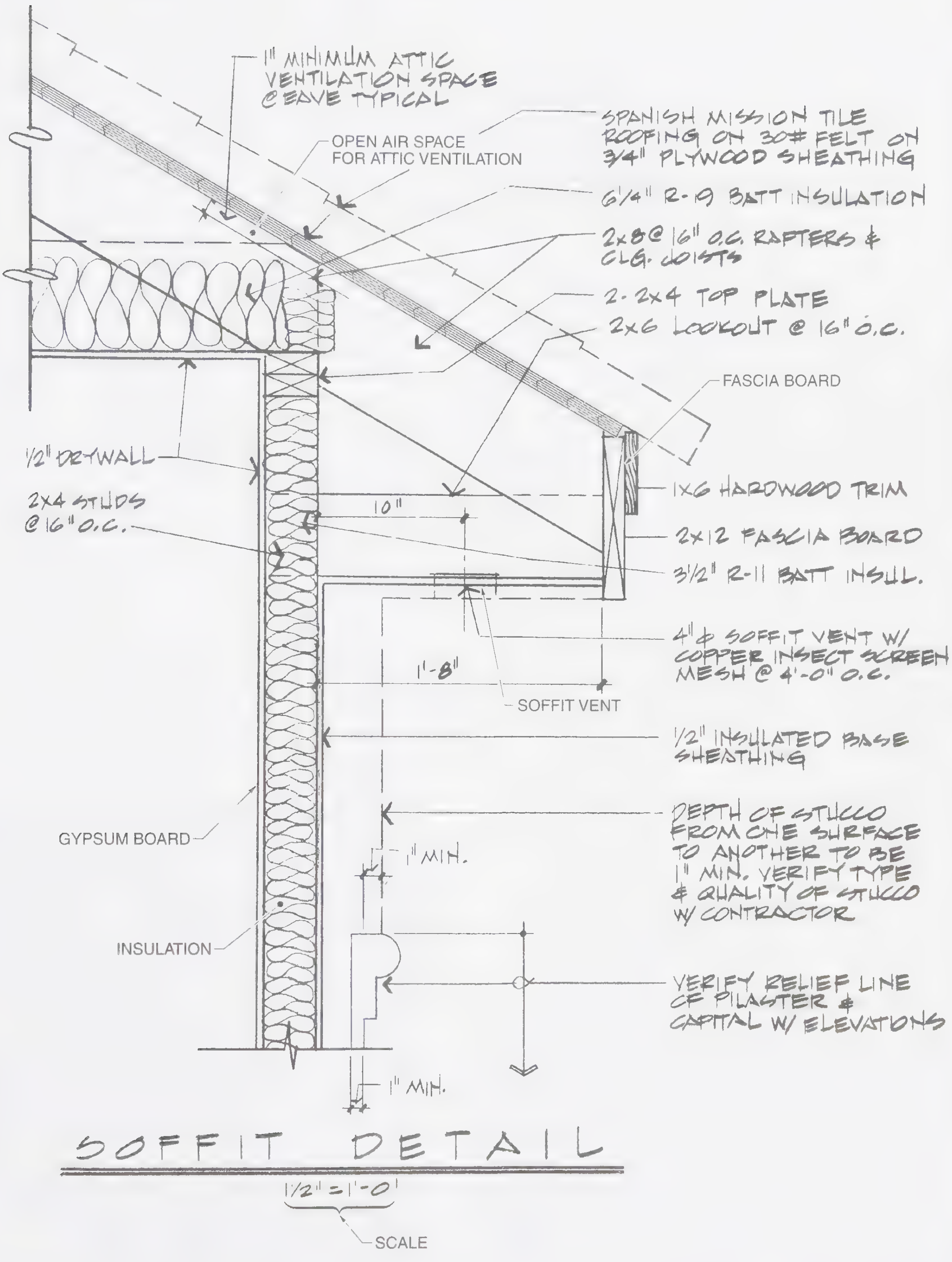


Figure 12-6. The soffit detail provides information regarding the soffit and roof framing and exterior wall finish.

Soffit Information

The soffit is framed level from the house wall to the bottom of the fascia with 2 × 6 blocking (lookouts) spaced 16″ OC. The ends of the rafters are finished with a 2 × 12 fascia board. A 1 × 6 hardwood trim board is attached to the outside of the fascia board at the top, directly under the clay tile roofing. Four-inch diameter vents are spaced 4′-0″ OC in the soffit. The vent openings are covered above with copper screening.

Plaster Information

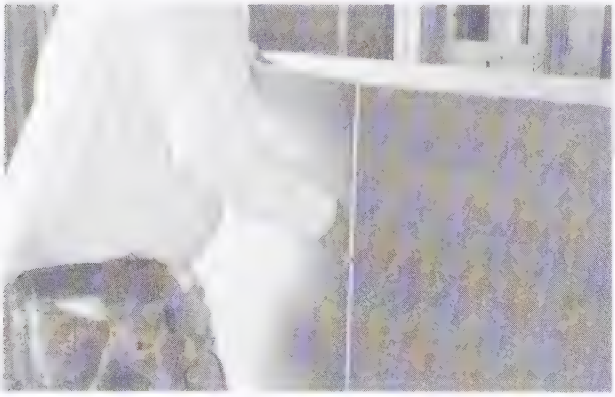
The bottom of the soffit and the exterior walls are covered with ½″ thick sheathing and a minimum of 1″ thick stucco. The outside face of the stucco is indicated with hidden lines. The type and quality of stucco applied to the house are to be verified with the contractor. An architectural notation indicates that the elevations provide the heights of the stucco relief lines around the house. The design of the pilaster and capital stucco finish are also shown.

Wall Information

The soffit detail indicates a double top plate on the exterior walls. Walls are insulated with 3½″ thick batts to provide an insulation rating of R-11. Exterior wall studs are spaced 16″ OC. The interior ceiling and walls are finished with ½″ thick gypsum board.

FIREPLACE DRAWINGS

Three drawings provided on sheet 5 include a variety of fireplace information. These drawings include an enlarged mantle detail, an interior elevation of the fireplace trim, and a section regarding the prefabricated fireplace installation. Each drawing is at a different scale.



Gypsum board is cut using a utility knife.

As shown on the Pre-Fab Fireplace section, a 2″ minimum clearance is required between the fireplace flue and the framing members where the flue passes through the second floor and roof. It is essential that this clearance be maintained to prevent excessive heat from being transferred from the flue to the framing members. The flue must be properly supported at the first-floor opening.

Mantle Detail

The mantle detail is drawn at a 3″ = 1′-0″ scale. The top of the mantle is a 1 × 10. A 1 × 6 is attached vertically to the wall to support the 1 × 10 mantle. A 2 × 10 is finished to 9″ wide and installed below the 1 × 10. The lower front edge of the 2 × 10 is coved. A 1 × 7 is attached to the bottom of the 2 × 10. Cove moldings, manufacturer number 8060 (WP92), are applied to trim the front of the 1 × 7 and the bottom of the 1 × 6 on the wall. The owner is to furnish and choose the design of the corbels.

Fireplace Elevation

The fireplace elevation is drawn at a ⅜″ = 1′-0″ scale. A wood mantle over the fireplace opening is supported by a corbel at each end. Blocks of paneling around the mantle and fireplace are shown. Tile facing is installed around the perimeter of the fireplace opening and on the hearth.

Pre-fab Fireplace

The section for the prefabricated fireplace is not to scale (N.T.S.). It shows a flue support and a fire collar installed around the flue at the ceiling joist line. The metal flue has a clearance of at least 2″ from the wood framing at the ceiling and roof.

DETAILS

Sections of building components and architectural notations about specific construction practices are included in the details. The details show shoe racks, pantry shelves, typical framing section construction, window framing and trim, plant shelf construction, valley board construction, and support sizes and spacings. These drawings are included on sheet 5.

Shelves

Two separate shelf details are provided—one for shoe racks and one for pantry shelves. Two details are included for each of these showing shelf spacing and construction of an individual shelf. Both details showing the shelf spacing are drawn to a 3/8″ = 1′-0″ scale. The individual shelf details are drawn to a 1½″ = 1′-0″ scale.

On the shoe rack detail, one level closet shelf is installed 6′-0″ above the floor. Four slanted shelves, each 11½″ wide, are installed 13″ apart, with the lowest shelf 8″ above the floor. A ¾″ × ¾″ cleat is attached to the top of each shelf 4″ from the back. Vertical supports are provided at each end of the shelves.

On the pantry shelf details, five shelves are installed in the pantry spaced 16″ apart. The pantry shelves are 11½″ wide with a ¾″ × ¾″ cleat at the front. The shelves are installed at an angle.

Typical Framing Section

The typical framing section shows typical wall and roof construction used throughout the house. Information found elsewhere on the prints that shows a particular building component constructed differently supersedes the typical framing section. The section is drawn to the scale of ¼″ = 1′-0″.

The floor is a concrete slab-on-grade with thickened footings beneath the exterior walls and interior bearing partitions. The finish grade around the building is sloped away from the house to ensure proper drainage.

Load-bearing walls are constructed perpendicular (at 90°) to ceiling and floor joists.

Wall Construction. The 2 × 4 bottom plate (sole) of the exterior walls is attached to the concrete slab with ½″ × 10″ anchor bolts spaced 6′-0″ OC. A 4″ × 30″ piece of asphalt-saturated building paper (felt) is installed between the bottom plate and the concrete slab. Typical wall construction is noted on the soffit detail. Diagonal 1 × 4 corner braces are notched into (let-in) the exterior wall studs with an option of full plywood sheathing. Insulation batts are installed between the exterior wall studs. Walls have a double 2 × 4 top plate lapped to interlock at all corners and intersections.

Framing for window openings is detailed on the section. All openings are framed with studs and trimmer studs, which support the headers. Double cripple studs are installed in openings over 6′-0″ wide. Windowsills are 2 × 4s. A header is installed over each window.

Roof Construction. Where the ceiling joists are set at 90° to the rafters, rafter ties are installed from the exterior wall at each rafter end to the closest ceiling joist. An L-shaped double 2 × 6 strongback is installed on ceiling joist spans greater than 10′-0″. Where flush beams are installed, joist hangers are attached to ceiling joists and beams for additional support. Ceiling insulation is 6″ thick batts.

Rafters are braced with 2 × 6 collar ties spaced 60″ OC, 2 × 4 braces spaced 60″ OC at more than a 45° angle, and 2 × 6 purlins. The roof ridge is a wood member, which is at minimum a 2 × 10. The soffit detail contains additional roof information.

Window Details

Section details of the window head, jamb, and sill, drawn at a 1½″ = 1′-0″ scale, are provided on sheet 5. A notation states that wood trim is omitted and replaced with gypsum board where the owner requests gypsum board returns on the inside of the windows rather than wood jambs.

The head detail shows exterior stucco finish and sheathing over the double header to the top of the window frame. A bead of caulk is applied between the stucco and window at the outside top. The inside of the window is trimmed with a wood jamb and casing.

The jamb detail indicates the wood stud and trimmer stud with space for ¼″ shimming at the side of the window. The outside sill extends a short distance onto the stucco. The interior sill projects farther from the window to provide a return for the interior wood casing.

The sill section shows a single-member wood-framed sill. A drip mold is installed below the exterior windowsill and above the exterior stucco. A hardwood interior sill projects into the room to allow for the application of a horizontal wood trim member (apron) below the interior sill.

Plant Shelves

Two details show plant shelves constructed between the two dining room walls and built into the bathing area wall. Both details are drawn at a 1½″ = 1′-0″ scale.

Solid 2× (1½″ actual thickness) blocking is installed between the two supporting framing members of the shelf. The top of the shelf is covered with ¾″ thick plywood. The shelf sides and bottom are covered with ½″ thick gypsum board. Wood trim molding at both sides of the shelf covers the joint of the plywood shelf and the gypsum board.

The plant shelf built into a wall is supported by a double top wall plate. Ceiling joists on top of the wall plates are covered with a ¾″ thick plywood shelf. A wood trim molding conceals the front edge of the plywood. A short wall of variable height, depending on the location of the shelf in the house as shown on the plan, is at the rear of the shelf, typically 1′-0″ deep. The ceiling and back wall of the shelf are typically covered with ½″ thick gypsum board.

Valley Board

The detail for the valley board is drawn at a 3/4″ = 1′-0″ scale. The valley board is a wood member, which at a minimum is a 2 × 10. Rafters are wood members, which at a minimum are 2 × 8s. Roof sheathing is ¼″ thick plywood. Weatherproofing in the valley is galvanized metal flashing, a minimum of 20″ wide.

Support Sizes and Spacing

A chart included with the details provides sizes and spacings for door and window headers and wood framing members. The chart for door and window header sizes shows the opening width (span) and type of header. For example, a 10′-0″ wide opening has a header constructed with double 2 × 12s. The chart for wood framing members indicates maximum spacing distances. The chart indicates that wall studs, ceiling joists, and rafters are spaced 16″ OC.

ROOF PLAN

The roof plan is drawn at a 1″ = 20′-0″ scale. See Figure 12-7. The entire roof has a 7″ unit rise per 12″ of unit run. The front of the house is at the bottom of the roof plan. Heavier object lines show the outline of the house at the fascia line and the fireplace flues as viewed from above. Lighter object lines show the hips, valleys, ridges, and crickets. Two flues and crickets are shown. One cricket is for the living room fireplace and the other is for the master bedroom fireplace. Hidden lines indicate the exterior wall and column locations. Extension and dimension lines from the exterior walls show the overall width (64′-4″) and depth (93′-0″) of the house at the wall line. Closely spaced lines at the left of the drawing represent 2 × 2s on the arbor roof.

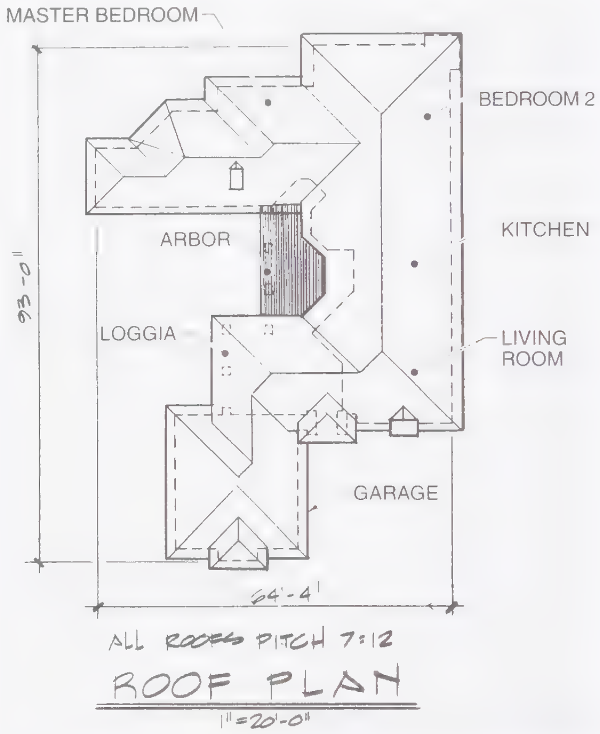


Figure 12-7. A roof plan shows the overall layout of the roof. Hidden lines indicate exterior wall and column locations.

ELECTRICAL PLAN

Electrical information is not included on the floor plan. Instead, a separate electrical plan is included as sheet E-1 of this set of prints. The house layout is shown on the electrical plan in the same position as on the floor plan, with the front of the house to the right of the sheet. Object lines show walls with door and window openings indicated. Hidden lines indicate the dining room planter shelves, kitchen cabinets, closet shelving, disappearing attic stairs, and interior opening headers.

A notation under the title of the electrical plan states that all electrical work is to conform to local and national codes, meaning the National Electrical Code® (NEC®). The NEC® is designed to provide guidelines for safe

installation of electrical wiring. Local permitting agencies adopt the NEC® and may make slight modifications to the code in certain areas.

Garage and Exterior Areas

One luminaire (lighting fixture) is to be installed on the front corner of the garage. The luminaire is controlled by a switch inside the door between the garage and loggia. Another switch next to this door controls an overhead interior luminaire in the center of the garage. A receptacle is installed in the garage ceiling next to the luminaire. A receptacle commonly installed in this location for an electric overhead garage door opener. Two more luminaires along the rear wall of the garage are controlled by another switch at the rear garage door. Three ground-fault circuit interrupter (GFCI) receptacles are installed in the rear garage wall.

Exterior Entry. Two luminaires on the front wall are controlled by a switch to the right of the front entry door. Two additional exterior luminaires outside the front entry door are controlled by three-way switches installed inside the rear garage door and the front entry door of the house. A receptacle is installed in the exterior wall to the right of the front loggia entry.

All 125 V, 15 A and 20 A receptacle outlets installed outdoors and in bathrooms, garages and accessory buildings, crawl spaces, unfinished basements, kitchens, and wet bar sinks must have ground-fault circuit interrupter (GFCI) protection.

Loggia and Arbor. A ceiling fan with a luminaire is located in the central area of the loggia. The fan motor and light are controlled with two individual switches located on the exterior of the rear garage wall.

Two additional luminaires are installed in the covered portion of the arbor area. One luminaire is outside the double French doors from the entry hallway, and the other luminaire is outside the master bedroom door. These two luminaires are controlled by three-way switches inside the entry door and master bedroom. Two receptacles are provided—one on the front exterior of the breakfast room and one next to the master bedroom door.

Entry/Living Room/Dining Room

The interior of the entry is illuminated with a single ceiling-mounted luminaire located in the center of the entry. This luminaire is controlled by a switch to the right of the front entry door. A receptacle is installed in the entry under the center window in the wall between the entry and the arbor.

Four single switches are installed in the living room wall at the right of the opening into the entry. Each switch controls one device or luminaire. The switched devices or luminaires are a ceiling fan in the center of the living room ceiling, a luminaire in the fan, a recessed luminaire in front of the fireplace, and one of the living room receptacles on the right exterior wall. Six other receptacles are installed in the living room—two at the fireplace, two in the media cabinet, one in the exterior wall, and one in the column near the entry. Two recessed lights in the living room ceiling above the media cabinet are controlled by a switch near the front wall.

The dining room has a central ceiling-mounted luminaire controlled by a switch on the column near the kitchen. There are four recessed ceiling luminaires, with two of the luminaires over each planter box in the dining room. All four of these luminaires are controlled by one switch located on the column between the living room and dining room. Two receptacles are located in the dining room.

Kitchen/Breakfast Area/Wet Bar

The kitchen has a 4′ square fluorescent luminaire in the center of the ceiling controlled by a switch to the right of the kitchen entry. See Figure 12-8. A switched ceiling-mounted luminaire is installed in the pantry, and a recessed ceiling luminaire is installed over the center of the double-bowl kitchen sink. Another switch on the exterior wall near the recessed light switch is installed to control the garbage disposal (food waste disposer). Six 110 V (volt) receptacles are installed in the kitchen.

Two GFCI receptacles are located near the sink. Two receptacles with 220 V each are installed for the ovens and the cooktop.

The breakfast room has a ceiling-mounted luminaire in the center controlled by a switch near the entry hall. There are two receptacles located in the breakfast room.

A ceiling-mounted luminaire is centered inside the window over the wet bar. One GFCI receptacle is installed above the wet bar countertop.

In the hallway around the wet bar, three ceiling-mounted luminaires are controlled by two three-way switches—one near the breakfast room and one near the master bedroom door. Another switch near the master bedroom door controls a recessed ceiling luminaire located in the hallway near the display shelves that are outside the master bedroom door. One receptacle is installed in this hallway near the door to bath 2. A smoke detector (SD) is installed in the hallway near the corner of the rear wall of the wet bar.

A three-way switch is an electrical switch used to control a luminaire (lighting fixture) from two different locations, such as near two different doors or openings entering a room.

Bath 2/Utility

Two luminaires over the vanity in bath 2 are controlled by three-way switches located at the two doors into bath 2 from the hallway and bedroom 2. Two GFCI receptacles are installed above the vanity. A switch near the vanity controls a ceiling-mounted luminaire in the bath 2 water closet area. A ceiling exhaust fan is controlled by a switch inside the bath 2 water closet area.

In the utility room, one ceiling-mounted luminaire is controlled by a switch located inside the utility room bifold doors. A 220 V and a 110 V GFCI receptacle are installed to accommodate a washer and dryer.

Bedrooms 2 and 3

Bedroom 2 has a ceiling-mounted luminaire installed in the center of the room and another located in the closet, each controlled by individual switches. Four receptacles are provided in bedroom 2, with one on each wall. The electrical installation in bedroom 3 is identical to bedroom 2, with two switched ceiling-mounted luminaires and four receptacles.

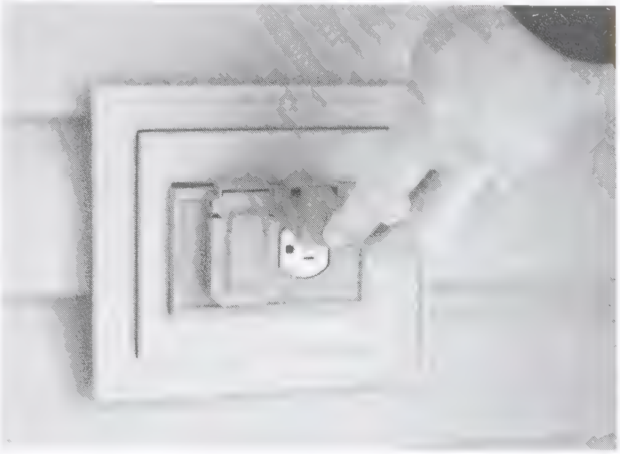
Master Bedroom

Two switches are located near the master bedroom double doors. One switch controls the ceiling fan in the center of the room. The other switch is a three-way switch connected to a luminaire in the ceiling fan. Another three-way switch for the ceiling fan luminaire is located near the entry into the linen area.

Three switches are located near the door between the master bedroom and arbor. One is a three-way switch controlling the arbor luminaire. Another switch controls the ceiling-mounted luminaire in the master bedroom ceiling. The third switch is connected to four recessed ceiling luminaires. Three of these luminaires are installed over the cabinets between the master bedroom and bathing area. The fourth recessed luminaire is located in the linen area.

Six receptacles are provided in the master bedroom walls. One additional receptacle is installed in the cabinet to the front side of the open fireplace. Two more GFCI receptacles are located in the television/videocassette recorder cabinet between the master bedroom and bathing area.

Bathing Area/Master Bath/Closet. One central ceiling-mounted luminaire in the bathing area is controlled by a switch in the master bath. Two luminaires are installed over the master bath double-bowl vanity. These luminaires are connected to a switch near the opening between the master bedroom and master bath. A GFCI receptacle is located at each end of the master bath vanity. A ceiling-mounted luminaire and exhaust fan are each connected to individual switches in the master bath water closet area. A switch inside the master bedroom closet controls two ceiling-mounted luminaires in the closet.



Two weatherproof ground-fault circuit interupter (WPGFCI) receptacles are to be installed in the arbor area.

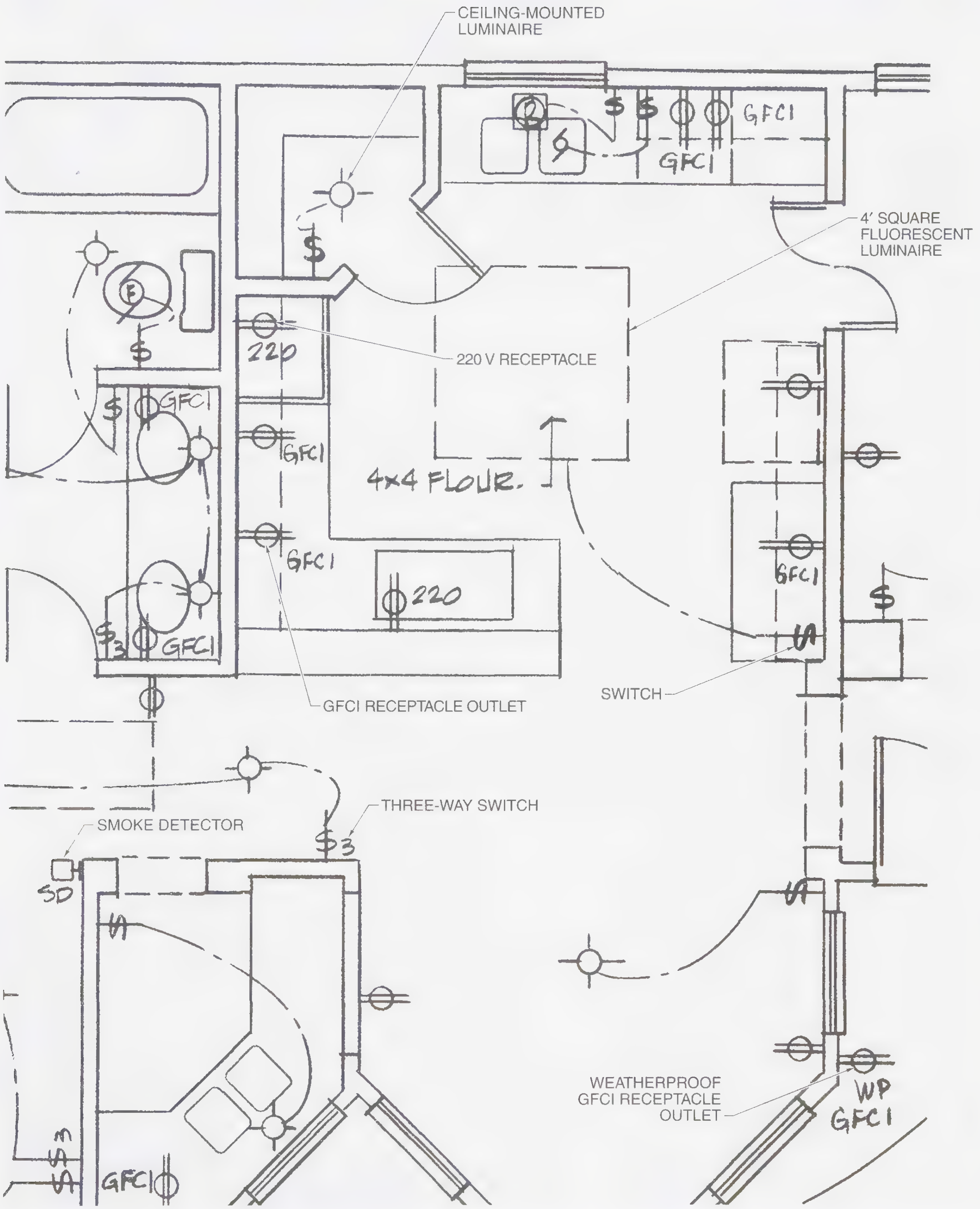


Figure 12-8. *An electrical plan shows the general location of electrical luminaires, switches, receptacles, and other electrical devices.*

Chapter 13

Printreading Exercises

The knowledge and study of the types of drawings, various line types, material symbols, and abbreviations are important in reading and interpreting residential prints. The ability to visualize and interpret the drawings into a completed house is also important and is best developed by studying various sets of prints.

Three sets of residential prints included in the Prints Folder are used in this chapter to assist in developing printreading skills. The prints should be studied from a builder's point of view and the point of view of the carpenter, electrician, plumber, HVAC technician, and other tradesworkers. The questions about each drawing are designed to help the printreader relate the information shown on the prints to the actual construction of each house.

EXERCISE 1
ALBERS PLANS

Printreading Exercises

Name ______________________ Date __________

SHEET 1

T F **1.** Air-entrainment is required for all concrete foundation walls.

______ **2.** Concrete piers must be ___″ below finished grade.

T F **3.** The minimum dead load structure requirement for ceiling joists is 20 lb/sq ft.

______ **4.** A substitute for metal flashing at valleys is ___.
- A. not allowed
- B. rolled roofing
- C. an additional layer of roof shingles
- D. 6 mil polyethylene

______ **5.** Foundation waterproofing must extend above the water table elevation by a minimum of ___″.

______ **6.** The IBC reference in the general notes is the ___.

T F **7.** Where two smoke detectors are installed in a residence, they must be connected to a common alarm system.

______ **8.** The brick veneer metal ties are to be ___ ga.

T F **9.** All foam plastic insulation must be separated from interior living areas by ⅜″ gypsum board.

______ **10.** A(n) ___ minimum access opening is required for attic areas.

______ **11.** Foundation crawl spaces must have a minimum of ___ vent(s).
- A. one
- B. two
- C. three
- D. four

T F **12.** Safety glazing is required for all bathroom areas less than 5′ above the floor.

______ **13.** The door sill at the attached garage must be ___″ above the finished garage floor.

T F **14.** Leaded art glass surrounding the front door is excluded from glazing safety requirements.

______ **15.** The door utilized as an entry into the garage must be ___″ thick.

______ **16.** The minimum insulation rating for the ceiling is ___.

T F **17.** The kitchen may be less than 70 sq ft.

______ **18.** Minimum habitable room ceiling height is ___.
- A. not indicated
- B. 7′-0″
- C. 7′-6″
- D. 8′-0″

T F **19.** Bathrooms with windows must exhaust a minimum of 50 cfm to the exterior of the building.

T F **20.** All electrical work must conform to the *1999 International Electrical Code.*

______ **21.** The maximum handrail diameter is ___″.
- A. 1
- B. 1½
- C. 2
- D. 2¼

______ **22.** The minimum spacing for weep holes in brick-veneer walls is ___″ OC.

SHEET 2

______ **23.** The abbreviation "SD" in the basement stairwell indicates a(n) ___.

T F **24.** All floor joist spacing is 16″ OC.

______ **25.** A(n) ___ steel beam is specified for the basement.

T F **26.** Footings below the steel columns are 36″ deep.

T F **27.** The area beneath the garage is to remain unexcavated.

______ **28.** The length of the recess in the foundation wall for the garage door is ___.

______ **29.** All foundation walls are to be ___ thick.

______ **30.** The rebar set in the frost wall near the front door are ___″ diameter.
- A. ¼
- B. ⅜
- C. ½
- D. ¾

T F **31.** There is one floor drain in the basement slab.

______ **32.** The electrical panel provides a(n) ___ A service.

______ **33.** The abbreviation "PC" near the unswitched basement luminaires stands for ___.

_______________ **34.** The opening width of the steel frame basement windows is ___.
- A. 20″
- B. 2′-0″
- C. 34″
- D. 6′-0″

_______________ **35.** The basement stair treads are ___ wide.

_______________ **36.** The abbreviation "WPGFI" below the optional bay window stands for ___.

T F **37.** A 4″ brick ledge is to be provided along the front of this residence for installation of the brick veneer.

_______________ **38.** The steel beam is to be ___ long to provide for minimum bearing in each beam pocket.

_______________ **39.** The distance from the face of the foundation wall below the front door to the face of the foundation wall for the double garage door is ___.
- A. 2′-0″
- B. 4′-0″
- C. 6′-0″
- D. none of the above

_______________ **40.** Excluding cantilevered floor sections, the longest dimension of the foundation wall from side to side is ___.

T F **41.** The luminaire in the basement stairway is controlled by a three-way switch.

T F **42.** Solid wood bridging is installed for all floor joists longer than 10′-0″.

SHEET 3

_______________ **43.** There are ___ freezeproof hose bibbs shown on the first floor plan.

T F **44.** Both fireplaces on the first floor are the same width.

_______________ **45.** The entry door is ___″ wide.
- A. 28
- B. 30
- C. 36
- D. 38

T F **46.** The front porch columns are 12″ square.

_______________ **47.** There are ___ rows of shelves in the kitchen pantry.

_______________ **48.** The door between the kitchen and the pantry is a ___ door.
- A. bypass
- B. pocket
- C. swinging
- D. bifold

_______________ **49.** The floor finish material for the living room is ___.

T F **50.** Front porch columns are offset from the edge of the front porch slab by 4″.

______ **51.** The abbreviation "S & R" inside the closet near the foyer indicates a(n) ___.

______ **52.** The steel beam near the single garage door is supported by ___.

A. brick veneer
B. steel columns
C. wood framing
D. microlam joists

T F **53.** The wall between the dining room and the garage is a load-bearing wall.

______ **54.** The floor finish material in the powder room is ___.

______ **55.** The center-to-center distance between the two windows along the front of the house is ___.

A. 6′-8″
B. 9′-0″
C. 10′-0″
D. 20′-0″

______ **56.** The area of the optional patio deck is ___ sq ft.

______ **57.** The solid black squares in the wall between the living room and the great room indicate ___.

A. plumbing chases
B. 4 × 4 columns
C. columns constructed with four 2 × 4s
D. steel columns

______ **58.** There are ___ duplex receptacle outlets shown in the living room.

T F **59.** A 220 V receptacle outlet is provided for the electric range.

______ **60.** The area of the dining room is ___ sq ft.

T F **61.** A sliding door is to be installed between the dining room and kitchen.

______ **62.** The center-to-center distance between the windows along the sides of the fireplaces is ___.

SHEET 4

T F **63.** There is one built-in shower unit on the second floor.

______ **64.** Roof trusses are to be spaced ___″ OC.

______ **65.** A total of ___ smoke detector(s) is/are to be installed on the second floor.

______ **66.** The wall between the office and stairway is to be ___ high.

A. 3′-0″
B. 4′-0″
C. 6′-8″
D. 7′-6″

______ 67. The linen closet in the master bedroom has ___ shelves.

______ 68. The attic access is located in the ___.
- A. laundry room
- B. foyer
- C. hallway near the stairway
- D. master bath

______ 69. The plumbing wall for bath 1 is to be ___″ thick.

T F 70. Two lavatories are to be installed in the master bath.

______ 71. The abbreviation “W.I.C.” indicates a(n) ___.

T F 72. Each bathroom has only one exhaust fan.

______ 73. The area of the second floor is ___ sq ft.

T F 74. One bifold door is to be installed on the second floor.

______ 75. The brick veneer on the front of the house is ___″ thick.

______ 76. The interior dimensions of the laundry are ___.

T F 77. All luminaires on the second floor are to be surface mounted.

______ 78. The fan in bath 1 provides ___ cfm of air circulation.
- A. 50
- B. 75
- C. 100
- D. 2468

______ 79. The interior wall between the master bedroom and the master bath is ___″ thick.

______ 80. The opening for the sliding door in the hall linen closet near the attic scuttle is ___ wide.
- A. 2′-1″
- B. 2′-10½″
- C. 4′-0″
- D. none of the above

______ 81. The angular hidden line extending through the master bath and master bedroom indicates a(n) ___.

______ 82. The stairway landing is ___ deep.

SHEET 5

T F 83. The windows along the front of the house are equal in width.

______ 84. The exterior finish material over the garage doors is ___.

______ 85. The abbreviation “T.O. FDN.” indicates ___.

T F **86.** All portions of the roof have an equal pitch.

______ **87.** The fascia board supporting the gutter is a ___ with a prefinished metal wrap.

A. 1 × 6
B. 1 × 8
C. 2 × 6
D. 2 × 8

______ **88.** The attic gable vent has ___ sq in. of surface area.

______ **89.** The decorative handrail enclosing the porch on the second story is ___″ high.

A. 20
B. 24
C. 30
D. 36

T F **90.** The floor-to-ceiling height of the basement is 2″ less than the floor-to-ceiling height of the first floor.

T F **91.** The headers over both garage doors are double 2 × 12s.

______ **92.** The roof over the front entry slopes a minimum of ___″ per 12″ of run.

______ **93.** Finish grade is a minimum of ___″ below the basement windows.

______ **94.** The typical width of the vinyl corner trim is ___″.

A. 1½
B. 2
C. 4
D. 8

______ **95.** Headers over all windows are constructed with ___.

A. 2 × 8s
B. 2 × 10s
C. 2 × 12s
D. microlam beams

______ **96.** The abbreviation "BRG. HT." stands for ___.

______ **97.** The fireplace is shown with hidden lines because ___.

A. it is hidden from view
B. it is an optional installation
C. this is common architectural practice
D. it projects from the face of the wall

______ **98.** The top of the fireplace flue is to be installed a minimum of ___ above the roof ridge.

T F **99.** Both overhead doors are the same height.

T F **100.** The brick soldier course above the first-floor windows is flush with the face of the brick veneer.

______ **101.** The abbreviation "DIA." at the front gable vent indicates ___.

______ **102.** Downspouts are shown with ___.
A. centerlines
B. object lines
C. hidden lines
D. abbreviations

SHEET 6

T F **103.** The supporting structure under the optional fireplace is wood framed.

______ **104.** Ceramic tile around the fireplace is ___″ square.

______ **105.** The overall width of the fireplace hearth is ___.

______ **106.** The minimum allowable distance from the prefabricated fireplace to a combustible material is ___″.
A. 2
B. 4
C. 6
D. 8

______ **107.** The height of the optional window seat is ___.

______ **108.** The minimum interior stair headroom is ___.

______ **109.** For safety, the maximum sphere opening on interior stair balusters is ___″.

______ **110.** Stair stringers are ___.
A. 9¼″ microlams
B. 1 × 10s
C. 1 × 12s
D. 2 × 12s

T F **111.** Unit rise dimensions are equal for all flights of the interior stairs.

______ **112.** Interior handrail height is ___.

T F **113.** The optional window above the bathtub in the master bath is square.

______ **114.** For a walkout daylight basement, the rear basement wall is ___.
A. exposed concrete
B. vinyl siding on concrete
C. vinyl siding on wood framing
D. brick veneer

T F **115.** The main roof of the house is finished with asphalt shingles.

______ **116.** The fascia board on the rear of the house is covered with ___.

______ **117.** The header above the triple window is constructed with ___.
A. a 3½″ × 9¼″ microlam
B. 2 × 10s
C. 2 × 12s
D. four 2 × 4s

T F **118.** Both sliding doors shown on the rear elevation are equal in height.

_______________ **119.** The roof pitch above the optional window seat is ___ on 12.

T F **120.** Four-inch vinyl corner trim is to be installed along the outside edges of the optional fireplace.

_______________ **121.** The overall distance from the basement floor to the finished floor of the second story is ___.

T F **122.** Headers for daylight basement windows are constructed the same as headers for first- and second-floor windows.

SHEET 7

T F **123.** All details on Sheet 7 are drawn to the same scale.

T F **124.** Cedar posts for the exterior deck are set into the concrete footings.

T F **125.** All wood members used to construct the exterior deck are cedar.

T F **126.** Galvanized joist hangers are used to support porch joists.

_______________ **127.** Two ___″ rebar are installed at the base of the garage foundation wall.

_______________ **128.** Subfloor material is ___″ thick.

_______________ **129.** The footing for a two-story house is ___ wide.

_______________ **130.** A(n) ___ mil vapor barrier is to be placed between the granular base and the concrete basement slab.

_______________ **131.** Where fascia is returned around the corner of an eave, the slope of the pitched area above the return is ___ on 12.

T F **132.** All shadow boards are 6″ wide.

_______________ **133.** The minimum slope of the finished grade away from the house foundation is ___″ per ft.

_______________ **134.** The crosshatch symbol to the right of the foundation wall on detail 4 represents ___.
- A. insulation
- B. gravel
- C. waterproofing
- D. earth

_______________ **135.** Anchor bolts embedded in the garage foundation walls are ___″ long.
- A. 4
- B. 8
- C. 12
- D. 48

_______________ **136.** Exterior sheathing is ___″ thick.

T F **137.** The garage floor is joined to the foundation wall with a 2 × 4 keyway.

_______________ **138.** The slope of the garage floor toward the door is ___″.
A. 1
B. 3
C. 4
D. none of the above

_______________ **139.** The sump pit is ___″ deep.

T F **140.** Felt roofing paper is installed under the roof shingles.

_______________ **141.** Roof trusses are to be spaced ___″ OC.
A. 12
B. 16
C. 24
D. 36

T F **142.** Perforated sections are to be installed along the closed soffit for ventilation.

_______________ **143.** Drain tile are to be ___″ diameter.

T F **144.** The second-floor ribbon board is a 2 × 12.

_______________ **145.** First-floor interior wall finish is ½″ ___.

T F **146.** A vapor barrier is to be installed on the inside face of the wood framing at exterior walls.

_______________ **147.** Joints in adjoining roof sheathing panels are reinforced with ___.

_______________ **148.** Sill plates are ___.
A. 1 × 4s
B. 2 × 4s
C. 2 × 6s
D. spaced 48″ OC

T F **149.** Under certain circumstances, drain tile may be installed along the exterior and interior edge of the footings.

SHEET 8

Front Elevation "B"

_______________ **150.** The gable trim above the front door has a(n) ___ radius.

_______________ **151.** The dormer (excluding overhang) is ___ wide.

T F **152.** Prefinished columns at the front porch are 12″ square.

_______________ **153.** There are ___ keystone-type members shown on front elevation "B".

T F **154.** The front porch roof has a 5 on 12 pitch.

_______________ **155.** Brick used to construct the windowsills are placed in a(n) ___ position.

_______________ 156. The first-floor shutters are ___″ wide.

T F 157. Front elevation "B" has an exterior finish of brick veneer on the first floor and vinyl siding on the second floor.

_______________ 158. The abbreviation "TEMP" on either side of the front door indicates ___ glass.

_______________ 159. The horizontal trim member above the second-floor windows is ___″ wide.

Front Elevation "C"

_______________ 160. The keystone above the first-floor windows is ___.
- A. brick
- B. shadow board
- C. limestone
- D. 4″ vinyl

T F 161. The three semicircular vents on the second floor are equal in diameter.

T F 162. There is no front porch offset shown on front elevation "C".

_______________ 163. The dormer window is ___″ wide.

_______________ 164. There are ___ downspouts discharging rainwater onto the short roof above the garage.

_______________ 165. The headers above all first- and second-floor windows are ___.
- A. 2×8s
- B. 2×10s
- C. 2×12s
- D. limestone

_______________ 166. The window above the entry door is ___″ in diameter.

T F 167. There are no shutters shown on front elevation "C".

T F 168. The side of the garage nearest the single overhead door is hidden from view on the partial left-side elevation for front elevation "C".

_______________ 169. Information regarding the wall-to-roof flashing referred to by Note 18 is included ___.
- A. on detail 18
- B. on Sheet 18
- C. on the general notes
- D. in the manufacturer's information

SHEET 9

_______________ 170. The rough opening for the double garage door is ___ wide.

_______________ 171. The front porch shown on front elevation "B" is ___ long.

__________ **172.** Joists for the front porch ceiling directly above the entry door are ___.
A. 2 × 8s
B. 2 × 10s
C. trusses
D. none of the above

T F **173.** One electrical receptacle outlet is to be installed on the front porch.

T F **174.** The columns along the front porch are ornamental and do not support any structural loads.

__________ **175.** The front porch is ___ deep from the front wall exterior finish.

__________ **176.** The offset in the second floor above the entry door is ___ wide.

T F **177.** The window in the second-floor offset above the entry door is centered.

__________ **178.** The front porch roof overhang is ___ wide.

T F **179.** There is no basement under the front porch or the garage.

__________ **180.** The center-to-center distance between the front windows in bedroom #2 and bedroom #3 is ___.

__________ **181.** The edge of the front porch column nearest the single garage door is installed ___″ from the face of the brick veneer.

T F **182.** The hidden line on the exterior of the partial second floor plan represents the edge of the footing.

__________ **183.** The series of eight short, bold, object lines on the partial basement plan at the front porch represent ___.
A. anchor bolts
B. the symbol for an unexcavated area
C. reinforcing steel
D. the direction of slope

__________ **184.** The thin object line in the center of the foundation wall below the entry door wall represents ___.
A. wall framing
B. a brick ledge
C. reinforcing steel
D. the roofline

T F **185.** The entry door swings out onto the front porch.

__________ **186.** The shelf in the open two-story foyer above the entry door is finished with ___.
A. plywood
B. gypsum board
C. oriented strand board
D. high-pressure laminate

__________ **187.** Second-floor trusses above the garage door area are spaced ___″ OC.

T F **188.** The porch columns to the right and left of the entry area are equally spaced.

T F **189.** The floor framing for the second-floor foyer shelf is 2 × 10s spaced 16″ OC.

SHEET 10

__________ **190.** The front porch for front elevation "C" has ___ sq ft of surface area.

__________ **191.** The openings between the front porch supports and the front wall are ___ wide.

__________ **192.** Front porch supports for front elevation "C" are ___.
- A. solid masonry
- B. brick veneer over wood framing
- C. concrete with brick veneer
- D. solid concrete

__________ **193.** The front porch supports shown on front elevation "C" are ___ wide.

T F **194.** Two wall-mounted luminaires are to be installed on the front porch.

__________ **195.** Roof trusses over the front porch are spaced ___″ OC.

__________ **196.** Foundation walls supporting the front porch are ___″ thick.

T F **197.** The front edge of the porch support structure is finished with 4″ of the concrete porch projecting beyond the face.

T F **198.** Headers for the roof trusses are double 2×10s.

__________ **199.** There are ___ window openings shown on the partial second floor plan for front elevation "C".

T F **200.** The foundation wall and footings are shown on the partial first floor plan for front elevation "C" with hidden lines.

13

EXERCISE 2
GROTPETER PLANS

Printreading Exercises

Name ______________________ Date ____________

Site Plan

T	F	1. The front steps are finished concrete.
T	F	2. All chain-link fences on the lot before construction are to remain in place during and after construction.
T	F	3. Three utility poles are located along the south property line.

______ 4. The rear property line is ___ long.
- A. 52′-202″
- B. 87′-52″
- C. 200.00′
- D. 202.00′

______ 5. The driveway is ___.
- A. 12′-0″ wide throughout
- B. 30′-0″ wide
- C. concrete
- D. connected at a 44′-0″ × 36′-0″ turnaround behind the house

______ 6. The height difference between the first-floor elevation and the basement floor elevation is ___.

______ 7. The right side of the house is ___ from the property line.

______ 8. The abbreviation S 87° 53′ E stands for ___.

Basement/Foundation Plan

T	F	9. Eight ceiling-mounted luminaires in the basement are controlled with pull chains.
T	F	10. The concrete brackets and buttress project 2′-0″ from the front foundation wall.

______ 11. The basement floor slab is ___″ thick.
- A. 2
- B. 3½
- C. 12
- D. 24

_______________ **12.** The foundation footing is ___″ wide by ___″ deep.

_______________ **13.** The amount of concrete required for the 10 concrete footing pads under the steel beams is ___ cu yd.

_______________ **14.** The abbreviation "F.D." indicates a(n) ___.

_______________ **15.** The steel columns in the basement are ___″ in diameter.

Front Elevation

T F **16.** The pitch of the garage roof is the same as the pitch of the front porch roof.

T F **17.** The center of the brick jack arch with brick key projects ¾″ from the face of the brick wall.

_______________ **18.** The main house foundation walls are ___″ thick.

A. 8
B. 10
C. 12
D. 24

_______________ **19.** ___ windows are to be installed along the front of the house.

A. Single-hung
B. Double-hung
C. Casement
D. Sliding

_______________ **20.** Shutters on the front of the house are ___.

A. louvered
B. panels
C. flush
D. none of the above

_______________ **21.** The finish material for the roof is ___.

A. roll roofing
B. clay tile
C. metal
D. asphalt shingles

_______________ **22.** The radius of the arched window in the front porch roof is approximately ___.

_______________ **23.** Steel lintels above the first-floor windows are ___″ wide by ___″ high by ___″ thick.

_______________ **24.** The second floor is ___ above the first floor.

Right Side Elevation

T F **25.** The footing under the garage offset is 8″ deep.

T F **26.** The top of the porch beam is 10¼″ above the house plate line.

_______________ **27.** The pitch of the rear dormer roof is ___ on 12.
A. 2
B. 3
C. 4
D. 7

_______________ **28.** Hidden lines at the front top of the front porch indicate ___.
A. the roof overhang and trim line
B. flashing
C. metal roofing
D. centerlines of the columns

_______________ **29.** The abbreviation "DS" indicates a(n) ___.

_______________ **30.** There are a total of ___ risers from the driveway to the front porch, each having a height of ___″.

_______________ **31.** The pilasters next to the front door are ___″ wide.

_______________ **32.** Front porch columns are ___″ in diameter.

Rear Elevation

T F **33.** Both overhead garage doors are the same size.

T F **34.** The wood casement windows to the right of the garage doors are flush with the brick wall.

T F **35.** A heavier lintel is installed at the bay window than at any other location on the rear of the house.

_______________ **36.** The second-floor windowsills are constructed with ___.
A. wood
B. stone
C. brick
D. metal

_______________ **37.** The abbreviation "WP51" stands for ___.
A. white pine grade 51
B. wood/painted #51
C. a manufacturer's molding product code
D. the location of the trim member on a detail

_______________ **38.** The three attic vent louvers are ___″ wide by ___″ high.

Left Side Elevation

T F **39.** The shaped midspan support at the front porch supports the center of the handrail.

T F **40.** The 28/36 window on the left side elevation also appears on the rear elevation.

_______________ **41.** The material used for the flue linings is ___.

_______________ **42.** The top of the wall at the basement exterior stairs is ___″ below the top of the foundation wall.

_______________ **43.** The abbreviation "TEMP GLS" indicates ___.

_______________ **44.** The concrete caps on the fireplace flues are ___″ high.

First Floor Plan

T F **45.** There are four recessed overhead luminaires in the kitchen controlled by three-way switches.

T F **46.** The living room fireplace is centered on the west wall.

T F **47.** The trusses in the day room are set parallel in a north-south direction.

T F **48.** The luminaire in the utility room is controlled by a pull chain.

_______________ **49.** The wallcovering between the house and garage is ___.

A. fire-rated drywall
B. metal
C. concrete masonry units and brick
D. standard drywall

_______________ **50.** The hearth in the living room is covered with ___.

A. brick
B. stone
C. ceramic tile
D. marble

_______________ **51.** Hidden lines in the family room from the front to the back of the house represent ___.

A. floor joists
B. wood ceiling beams
C. electrical conduit
D. parquet flooring

_______________ **52.** The door into the powder room is a ___-hand swinging door.

_______________ **53.** The abbreviation "CO" at the foyer indicates a(n) ___.

_______________ **54.** The door between the dining room and kitchen is a double-acting door that is ___ wide.

_______________ **55.** There are ___ weatherproof receptacle outlets shown on the first floor plan.

_______________ **56.** The abbreviation "O'HD" in the garage indicates ___.

_______________ **57.** The stairway from the first floor to the basement has ___ risers.

Second Floor Plan

T F **58.** There are two ceiling-mounted luminaires in bath #3.

T F **59.** Bath #2 cannot be entered without walking through the sitting room.

_______ **60.** The floor in bath #4 is covered with ___.
- A. ceramic tile
- B. carpeting
- C. resilient flooring
- D. parquet

_______ **61.** Wood trusses are spaced ___″ OC.
- A. 12
- B. 16
- C. 24
- D. 30

_______ **62.** The whirlpool tub is ___″ wide by ___″ long.

_______ **63.** The cost of the carpet is $18.75 per sq yd. The total cost for the carpet in bedroom #4 is $___.

_______ **64.** The abbreviation "WIC" in bedroom #3 indicates a(n) ___.

_______ **65.** There is/are ___ medicine cabinet(s) in bath #4.

_______ **66.** There are ___ receptacle outlets in the sitting room.

Porch and Entrance Detail

T F **67.** The molded trim over the front door is approximately 5½″ wide.

T F **68.** Lintels over the front door and the second-floor bedroom door are the same thickness.

T F **69.** The front door is 7′-0″ high.

_______ **70.** The concrete and brick porch slab rests on ___.
- A. crushed rock
- B. concrete piers
- C. compacted earth
- D. plastic film

_______ **71.** Brick treads and risers are placed on ___.
- A. gravel
- B. concrete
- C. wood subfloor
- D. compacted earth

_______ **72.** The concrete slab for the front porch is ___″ thick.

_______ **73.** Bricks are attached to the foundation wall with dovetail anchor slots spaced ___″ OC.

Eave and Porch Details/Eave Section thru Gutter

T F **74.** The gutter shown on the eave section is also shown on the left side elevation.

______ **75.** The roof sheathing is ___″ thick.

A. ¼
B. ⅜
C. ½
D. ⅝

______ **76.** The dentil blocks are ___.

A. ½″ × 3″ × 3″
B. 4″ × 4″ × 5″
C. 4″ × 4″ × 5½″
D. 2″ × 2″ × 2½″

______ **77.** The porch handrail is ___ high.

______ **78.** The porch ceiling is finished with ___.

Wood Column Cap Detail @ Bar & Breakfast Room

______ **79.** The wood column cap detail is drawn at a(n) ___″ = 1′-0″.

______ **80.** The flitch beam is composed of two 2 × 12s with a ½″ ___ between them.

General Notes

T F **81.** The smoke detectors use alternating current.

______ **82.** Unless otherwise indicated, exterior opening headers are constructed with 2 × ___s.

A. 6
B. 8
C. 10
D. 12

______ **83.** Each bearing partition is supported with ___ floor joists.

Concrete Retaining Wall Detail

T F **84.** The retaining wall is centered on the footing.

______ **85.** The vertical reinforcing steel spaced 12″ OC has a(n) ___″ diameter.

______ **86.** The brick veneer is tied to the concrete wall with dovetail anchor bolts spaced ___″ OC.

Porch & Bracket Detail

______ **87.** The total height from the bottom of the concrete bracket to the top of the porch floor at the house is ___.

A. 3′-5″
B. 3′-7″
C. 4′-1″
D. 4′-2″

_______________ **88.** The frost wall is ___″ thick.

_______________ **89.** The centerline of the porch column is ___ from the outside of the frost wall.

Bathroom Elevations

T F **90.** Two recessed luminaires in the master bath are spaced 3′-0″ OC.

_______________ **91.** The shower area walls in bath #2 are finished with ___.

A. fiberboard
B. drywall
C. tempered glass
D. ceramic tile

Fireplace Sections

T F **92.** The library fireplace wall is finished with drywall.

T F **93.** The details for the library, living room, and master bedroom sitting room fireplaces are similar.

_______________ **94.** The distance from the bottom of the lintel to the bottom of the damper is ___″.

_______________ **95.** The minimum thickness of the concrete below the fireplace is ___″.

Fireplace Elevations

_______________ **96.** The hearth in the family room fireplace is ___ high.

Stair Section

T F **97.** The minimum headroom distances for the basement stairway and second floor stairway are the same.

_______________ **98.** Balusters are spaced 6″ OC. The total number of balusters required for the level section of handrail on section "A"-"A" is ___.

Typical Wall Section

_______________ **99.** The 2 mil polyethylene vapor barrier is installed ___.

A. under the basement floor slab
B. outside the basement walls
C. between the wall studs and drywall
D. between the wall studs and exterior sheathing

_______________ **100.** The total height from the bottom of the footing to the top of the truss chord is ___.

EXERCISE 3
JONESMAYER PLANS

Name ____________________ Date ____________

Basement/Foundation Plan

T F 1. The garage and house footings are the same size.

T F 2. All the basement windows are on one side of the basement.

T F 3. There are five floor drains in the basement floor.

________ 4. The steel columns are ___″ in diameter.
- A. 3½
- B. 11
- C. 12
- D. 30

________ 5. Welded wire reinforcement in the garage is made of ___ ga wire.
- A. 4
- B. 6
- C. 10
- D. 11

________ 6. House footings project from both sides of the basement foundation walls ___″.
- A. 2
- B. 4
- C. 5
- D. 7

________ 7. There are ___ luminaires in the basement controlled by pull chains.

________ 8. The abbreviation "W.H." indicates a(n) ___.

________ 9. If the steel beam at the front offset is ordered in one piece and rests in the two beam pockets 4″ at each wall, the length of the beam is ___.

________ 10. The garage floor is ___″ thick.

________ 11. A total of ___ 2 × 10 × 14′ floor joists should be ordered for the front section of the subfloor from the garage to the right side foundation wall.

________ 12. Concrete costs $28.75 per cu yd. Allowing 5% for waste, it will cost $___ for the concrete required for the basement floor.

________ 13. Foundation walls are ___″ thick.

First Floor Plan

T F **14.** The drain in the master bath shower is located in the center of the shower.

T F **15.** There are no ceiling-mounted luminaires in the family room.

T F **16.** The door between the house and the garage is a 2′-8″ wide left-handed swinging door.

T F **17.** The dining room has a raised floor.

T F **18.** The study has four electrical receptacle outlets.

T F **19.** The 18″ vanity base cabinet in the master bath has three drawers.

______ **20.** The floor in the kitchen pantry is raised because of the ___.
- A. ease of reaching the shelf
- B. size of the door
- C. electrical wiring underneath
- D. none of the above

______ **21.** The front window in the dining room is ___.
- A. glass block
- B. single-hung
- C. double-hung
- D. a bow window

______ **22.** The hidden lines in the area to the left of the kitchen represent ___.
- A. a washer and dryer
- B. floor drains
- C. soffit framing
- D. a stairway to the attic

______ **23.** Hidden lines at the opening between the foyer and the dining room represent ___.
- A. a step up
- B. a header
- C. electrical circuits
- D. shelves

______ **24.** The abbreviation "CA" between the living room and family room indicates ___.

______ **25.** The front porch slab is attached to the foundation with rebar spaced ___ OC.

______ **26.** The optional patio door frame is made of ___.

______ **27.** Carpet costs $32.65 per sq yd. The cost for the carpet in the living room is $___.

______ **28.** The heights of the countertops in the bar are ___″ and ___″.

______ **29.** There are ___ heating ducts in the family room.

______ **30.** Allowing ½″ for the astragal between the doors and 1″ at each side for the door jamb, the front door rough-framed opening should be ___ wide.

_______________ 31. The opening between the master bedroom and the master bath is ___ wide.

_______________ 32. The inside width dimension of the closet in bedroom #4 is ___.

Front Elevation

T F 33. All door and window headers on the front elevation are constructed the same.

T F 34. The roof pitch is 6″ of unit rise for each 12″ of unit run.

T F 35. The front doors are six-panel doors.

T F 36. Eight shutters should be ordered for the front of the house.

_______________ 37. The front porch piers are ___″ in diameter.
- A. 2
- B. 4
- C. 6
- D. 8

_______________ 38. Roof overhang is typically ___.
- A. 6″
- B. 1′-0″
- C. 1′-6″
- D. 2′-0″

_______________ 39. Siding on the front of the house is ___.
- A. board-and-batten
- B. horizontal lap
- C. vertical lap
- D. stucco

_______________ 40. Front porch posts are ___ high from the ground level.

_______________ 41. The abbreviation "DS" indicates a(n) ___.

_______________ 42. The flashing on the garage roof is used to prevent leaks around the ___.

_______________ 43. The front porch piers are drilled a minimum of ___ deep.

_______________ 44. Each garage window has a total of ___ sq in. of opening, including both the upper sash and lower sash.

_______________ 45. The abbreviation "CONC FDN" indicates a(n) ___.

_______________ 46. The ceiling height is ___.

General Notes

T F 47. Firestopping is required at all soffits and dropped ceilings.

_______________ 48. Appendix ___ of the building code must be referred to for proper nailing methods.

__________ **49.** Drywall joints are taped to ___.
- A. determine wall thickness
- B. cover the joints between pieces
- C. ensure proper attachment to framing members
- D. check stud spacing

Site Plan

T F **50.** The highest point on the lot is at the rear right corner.

T F **51.** The front building line is 30′ from the street.

__________ **52.** The width of the easement is ___.
- A. 10′-0″
- B. 30′-0″
- C. 98′-0″
- D. 100′-0″

__________ **53.** The south property line is ___ long.
- A. 90′-0″
- B. 100′-0″
- C. 140′-0″
- D. 100.50′

__________ **54.** The street in front of the house is ___.

__________ **55.** The elevation of the first floor is ___′.

__________ **56.** The curved portion of the driveway has a(n) ___ radius.

__________ **57.** The bearing of the east property line is ___.

__________ **58.** The easement contains a total of ___ sq ft of property.

__________ **59.** The distance from the property line to the building line at the east side of the house is ___.

Right Side Elevation

T F **60.** The roof pitch of the entire house is 6 on 12.

__________ **61.** The rake board is a ___.
- A. 1 × 2
- B. 2 × 4
- C. 1 × 6
- D. 1 × 8

__________ **62.** Allowing for floor framing to be 11¾″ high and the basement floor to be 2″ above the footing, the height of the basement ceiling from the basement floor is ___.

__________ **63.** The window manufacturer product codes refer to the ___ Corporation.

__________ **64.** Splash blocks are made of ___.

_______________ **65.** The horizontal siding is ___″ wide.

_______________ **66.** The louver on the right elevation provides ___ sq in. of ventilation.

Left Side Elevation

T F **67.** There is a light in the left-side door.

T F **68.** Shingles in the roof valleys are cut to fit each other.

_______________ **69.** The item projecting above the gable on the left side of the drawing is a ___.

A. fireplace flue
B. furnace flue
C. cupola
D. plumbing stack

_______________ **70.** The gutter is fabricated of ___.

_______________ **71.** The louver on the left side elevation provides ___ sq in. of ventilation.

Rear Elevation

T F **72.** All headers on the rear elevation are to be framed the same.

T F **73.** Four downspouts are shown on the rear elevation.

T F **74.** The fireplace flue projects a minimum of 2′-0″ above the top of the plate line.

T F **75.** The saddle shown on the rear elevation is the same one shown on the front elevation with hidden lines.

_______________ **76.** A brick soldier course at the top of the chimney refers to bricks placed ___.

A. vertically
B. horizontally
C. without mortar
D. with extra reinforcement

_______________ **77.** The flashing around the chimney must project a minimum of ___″.

_______________ **78.** The abbreviation "TYP" stands for ___.

Section @ Eave w/ Brick

T F **79.** The attic insulation is blown in place to a depth of 6″.

T F **80.** Ceiling joists are spaced 16″ OC and rest on a double 2 × 4 top plate.

_______________ **81.** The abbreviation "INSUL" indicates ___.

_______________ **82.** Both ceiling drywall and wall drywall are ___″ thick.

Section @ Gable

_______________ **83.** A 2 × 4 is placed on edge to ___.
- A. support the overhang
- B. align the rafters
- C. support the roof sheathing
- D. provide additional insulation

_______________ **84.** Wood trusses are spaced ___ OC.

_______________ **85.** The abbreviation "MTL" indicates ___.

_______________ **86.** There are three bundles of shingles in a square. The weight of one bundle of shingles for this roof weighs ___ lb.

_______________ **87.** The drawing is drawn at a(n) ___ scale.

Section @ First Floor (Brick and Siding)

T F **88.** Wall studs are spaced 16″ OC.

T F **89.** The brick veneer is laid on top of the wood subfloor.

T F **90.** The bottom course of brick must be at least 8″ above the grade line.

T F **91.** Brick ties are to be spaced 16″ OC vertically and horizontally.

_______________ **92.** The anchor bolts are ___″ in diameter.
- A. ½
- B. 1
- C. 2
- D. 4

_______________ **93.** Underlayment is ___.
- A. plywood
- B. particleboard
- C. IBC-approved
- D. 1″ thick

_______________ **94.** The abbreviation "FLR" indicates ___.

_______________ **95.** A total of ___ anchor bolts are required for 238 lf (linear feet) of foundation wall.

Section @ Basement

T F **96.** Dampproofing stops at the junction of the foundation and footing.

T F **97.** The concrete slab is 4″ thick.

Fireplace Section

T F **98.** The wood mantel must be at least 3½″ from the top of the fireplace opening.

T F **99.** The lintel is made of stone.

_______________ **100.** The inner face of the fireplace opening is constructed with ___.
- A. concrete
- B. stone
- C. face brick
- D. firebrick

_______________ **101.** The offset from the front of the flue to the front of the smoke shelf is ___″.
- A. ½
- B. 4
- C. 9
- D. 12

_______________ **102.** The area between the flue and the face brick is ___.

_______________ **103.** The rebar under the fireplace are ___″ in diameter.

_______________ **104.** The hearth is ___ high and ___ wide.

Stair Section

T F **105.** The plywood-covered platform is at first-floor level.

_______________ **106.** Stair nosing is typically ___″.

_______________ **107.** The maximum spacing between the safety rails is ___″.

_______________ **108.** If the stair is 3′-6″ wide, ___ lf (linear feet) of tread material should be ordered.

_______________ **109.** The abbreviation "MTL JST HANGER" indicates a(n) ___.

_______________ **110.** The total rise of the stairs is ___.

Title Block

_______________ **111.** The architect is registered in the state of ___.

_______________ **112.** The building is located on lot number ___.

_______________ **113.** The building lot is located in block number ___.

_______________ **114.** The architect's registration number is ___.

_______________ **115.** The building is located in the city of ___.

CHAPTER

14 Printreading Final Exam

Each drawing in a set of residential prints illustrates a certain portion of a house. The various drawings may be interrelated or they may be independent of other drawings.

A skilled printreader can quickly answer a question about the building by turning to the correct drawing without having to search each individual sheet. For example, when a question is posed on the job site regarding the size of joists for the second floor, a knowledgeable printreader refers to the first floor plan and the typical wall section to determine the answer. Specifications and general notes may also be referred to in order to verify accuracy.

In the previous chapter, questions were divided into separate sections pertaining to individual drawings or sheets. For the Final Exam, questions do not refer to a particular drawing or sheet, but are comprehensive. This is designed to sharpen the printreader's ability to quickly determine where specific types of information are shown on the prints. After locating this information, the final step for the printreader is accurate interpretation of the building component or material shown.

CHAPTER 14

BRAZLEY PLANS

Printreading Final Exam

Name ______________________ Date ____________

True-False

T F **1.** There are three aluminum sliding doors on the main floor.

T F **2.** There are no double-hung windows in the house.

T F **3.** The crawl space slab is 4″ higher than the garage floor.

T F **4.** The garage heat is supplied by the main furnace.

T F **5.** The roof vent for the dishwasher and kitchen sink is smaller than the other two sanitary roof vents.

T F **6.** There is drain tile around the entire perimeter of the basement.

T F **7.** Floor joists for the first floor are 2 × 12s.

T F **8.** The front porch concrete slab is level.

T F **9.** The building lot slopes from the high point at the southwest to the low point at the northeast.

T F **10.** The footings for foundation walls are 1′-8″ wide.

T F **11.** The front and back property lines are parallel.

T F **12.** The 15″ × 8″ dimension in the center of the garage refers to the air conditioning.

T F **13.** The water shutoff valve location is shown on the elevations.

T F **14.** The floor of the family room is supported by a 2 × 4 knee wall.

T F **15.** The top of the concrete foundation wall is lower on the east side of the front porch slab.

T F **16.** The living room floor and family room floor are at the same elevation.

T F **17.** The air conditioner is located on the south side of the sewing room.

T F **18.** The front door is an insulated metal door.

T F **19.** All ceilings are finished with drywall.

T F **20.** All ceiling insulation is 6″ blown-in insulation.

T F **21.** The elevation of the balcony for the second floor is 8′-0″.

T F **22.** The hidden line in the driveway on the plot plan indicates a drain.

T F **23.** The water shutoff valve is in an easement in front of the house.

T F **24.** There are three different fill materials used under the basement floor, crawl space floor, and garage floor.

T F **25.** The elevations are drawn to a ¼″ = 1′-0″ scale.

T F **26.** The living room window that is partially hidden on the east elevation and the highest living room window on the north elevation are installed at the same height.

T F **27.** The south aluminum double sliding door is set into the screen wall.

T F **28.** There is a flat porch over the entry slab.

T F **29.** The flue for the water heater is south of the foyer and east of the breakfast room.

T F **30.** The entry doors for bedroom #2 and bedroom #3 are identical.

T F **31.** The kitchen exhaust fan has a capacity of 120 cfm.

T F **32.** The opening between the dining room and the central hallway into the master bedroom has no header over the pass-through.

T F **33.** The sump pump basin is encased in 2″ of concrete.

T F **34.** The overhead luminaire in bedroom #2 is operated by a three-way switch.

T F **35.** All the bathroom exhaust fans are vented through the roof.

T F **36.** The insulation in the outside walls is placed toward the inside of the walls.

T F **37.** The gutter is 5″ wide.

T F **38.** The garage floor elevation is 0′-0″.

T F **39.** Rafters and ceiling joists are placed 16″ OC over bedroom #3.

T F **40.** All wall studs are spaced 16″ OC.

T F **41.** Two floor drains are shown on the basement floor and foundation plan.

T F **42.** The electrical panelboard location indicates that the electric service will enter the house from the front.

T F **43.** The door between the dining room and screen area is an aluminum sliding door.

T F **44.** Closet #1 has five shelves.

T F **45.** All kitchen wall cabinets are 30″ high.

T F **46.** The exterior of the garage door is metal.

T F **47.** The portion of the front porch slab that is at elevation 5′-2″ is 13′-8″ long.

T F **48.** There is 3′-4¾″ headroom in the crawl space.

T F **49.** The concrete portion of the east family room wall is furred out with ¾″ thick lumber.

T F **50.** The concrete entry slab is 7″ thick.

Multiple Choice

______________ **51.** The weight of the roof shingles is ___.
- A. 240 lb per bundle
- B. 240 lb per square
- C. 720 lb per square
- D. none of the above

______________ **52.** The south wall of the screen area is supported with ___.
- A. a masonry foundation
- B. piles
- C. concrete piers
- D. a concrete foundation wall

______________ **53.** The two longest overall length and width dimensions are ___.
- A. 58′-0″ × 52′-0″
- B. 42′-0″ × 62′-6″
- C. 58′-0″ × 62′-6″
- D. none of the above

______________ **54.** The 4′-4″ dimensions on the east garage foundation wall refer to ___.
- A. centerlines for window placement
- B. height changes in the basement wall
- C. electrical receptacle outlet locations
- D. garage door locations

______________ **55.** The house living areas are heated with ___.
- A. central gas heat
- B. central electric heat
- C. hot water radiant heat
- D. individual electric heating units

______________ **56.** The hot water supply pipes are ___″ in diameter.
- A. ¼
- B. ½
- C. ¾
- D. 1

57. This house is ___ construction.
 A. platform-framed
 B. balloon-framed
 C. plank-and-beam framed
 D. masonry

58. The front steps are constructed with ___.
 A. concrete
 B. railroad ties
 C. wood
 D. none of the above

59. The sanitary sewer service is provided from a pipe with a(n) ___″ diameter.
 A. 1
 B. 6
 C. 8
 D. none of the above

60. The finish for the wood-framed walls in the basement area is ___.
 A. 1/4″ paneling
 B. 1/2″ gypsum board
 C. oriented strand board
 D. building paper

61. The floor finish material in the breakfast room is ___.
 A. ceramic tile
 B. vinyl tile
 C. carpet
 D. 4″ rubber

62. Bedrooms #2 and #3 are air conditioned with ___.
 A. a central unit
 B. individual window units
 C. a swamp cooler
 D. none of the above

63. The ___ door of scheduled door #13 is movable.
 A. east
 B. center
 C. west
 D. none of the above

64. The supply-air floor registers are ___.
 A. all the same length
 B. 2″ wide
 C. located against interior walls
 D. of random length and width

65. The hidden line between the living room and family room indicates ___.
 A. the second floor balcony
 B. a step down into the family room
 C. electrical circuits for the outlets in the west wall
 D. gas pipes for a fireplace log lighter

_______________ **66.** The roof sheathing is ___″ thick.
A. ¼
B. ⅜
C. ½
D. ⅝

_______________ **67.** The exterior siding is ___.
A. 4′ × 8′ sheets
B. shiplap
C. tongue-and-groove
D. nailed directly to the studs

_______________ **68.** The balcony handrail is ___.
A. 4′-1″ high
B. supported by ½″ diameter oak dowels
C. made of a double 2 × 10
D. none of the above

_______________ **69.** The drain tile is ___″ in diameter.
A. 2
B. 3
C. 4
D. 5

_______________ **70.** The exterior south wall of the family room is constructed with ___ studs.
A. 2 × 4
B. 2 × 6
C. 2 × 8
D. 2 × 10

_______________ **71.** There is/are ___ rebar set in the concrete foundation walls.
A. one
B. two
C. three
D. four

_______________ **72.** The horizontal floor support on either side of the fireplace is a ___.
A. wood beam
B. wood girder
C. steel beam
D. steel girder

_______________ **73.** The hidden lines at the top of the roof on the east elevation indicate ___.
A. fascia
B. coping
C. flashing
D. siding

_______________ **74.** The walls around bath #2 are ___.
A. the same thickness
B. insulated
C. made of concrete masonry units
D. plaster

______ **75.** The difference in elevation between the living room floor and dining room floor is ___.
A. 3′-11″
B. 4′-7″
C. 4′-9″
D. 9′-0″

______ **76.** Wood baseboard is installed in the house in the ___.
A. living room
B. family room
C. master bedroom
D. none of the above

______ **77.** A(n) ___ water heater is used to heat water for the house.
A. gas
B. electric
C. solar
D. all of the above

______ **78.** The interior south partition between the family room and the master bedroom is ___″ thick.
A. 5
B. 6
C. 10
D. 12

______ **79.** The anchor bolts for the wall plates are ___″ long.
A. ½
B. 8
C. 12
D. 20

______ **80.** The floor between the family room and the crawl space ___.
A. is constructed with 2 × 12 floor joists
B. has an elevation of 5′-9″
C. is not insulated
D. is covered with vinyl tile

______ **81.** The posts for the screen area are ___.
A. wrought iron
B. wood
C. steel
D. concrete

______ **82.** The luminaires in the basement area are controlled by ___.
A. one switch
B. a three-way switch
C. pull chains
D. two separate switches

______ **83.** ___ windows are to be installed in the living room.
A. Fixed-glass
B. Casement
C. Double-hung
D. Sliding

_______________ **84.** According to the door schedule, door #24 is a ___ door.
- A. swinging
- B. double-acting
- C. sliding
- D. bifold

_______________ **85.** The portion of the fireplace below the family room floor is constructed with ___.
- A. concrete
- B. concrete masonry units
- C. wood
- D. steel

Completion

_______________ **86.** There is/are ___ row(s) of bridging installed in the studio floor.

_______________ **87.** The gas line into the house is ___″ in diameter.

_______________ **88.** The concrete wall to the east of the crawl space is ___″ thick.

_______________ **89.** First floor joists are spaced ___″ OC.

_______________ **90.** The steel beams in the basement are ___″ high.

_______________ **91.** The distance from the northeast corner of the front of the house to the property line is ___.

_______________ **92.** The east side property line is ___ long.

_______________ **93.** The dimensions of the fireplace footing are ___.

_______________ **94.** There are ___ duplex electrical receptacle outlets in the garage.

_______________ **95.** The concrete foundation walls are ___″ thick.

_______________ **96.** There are ___ risers in the front entry steps from the driveway to the front porch.

_______________ **97.** The siding is installed at a(n) ___° angle, with the exception of the front entry area.

_______________ **98.** The elevation of 0′-0″ on a drawing is equal to ___ above mean sea level.

_______________ **99.** The kitchen exhaust is on a(n) ___-phase circuit.

_______________ **100.** The windows in the family room are ___ windows.

_______________ **101.** The actual height above mean sea level to the top of the family room windows is ___.

_______________ **102.** There are ___ duplex receptacle outlets in the master bedroom.

_______________ **103.** The exhaust fan in bath #1 is vented to the outside with a(n) ___″ diameter pipe.

_______________ 104. The abbreviation "PS" in the sewing room closet indicates a(n) ___.

_______________ 105. In terms of compass direction, the kitchen sink is located on the ___ wall of the kitchen.

_______________ 106. ___ gallons of water can be contained in the water heater.

_______________ 107. The rubber baseboards are ___″ wide.

_______________ 108. Anchor bolts are placed in the top of the foundation wall ___ OC.

_______________ 109. The interior soffits project down from the ceiling ___″.

_______________ 110. The rebar in the concrete footings is placed a minimum of ___″ from the bottom of the footing.

_______________ 111. The length of the rear property line dimensions when converted to feet and inches is ___.

_______________ 112. The gas meter is supplied by the ___.

_______________ 113. The rebar in the concrete foundation wall and footings are ___″ in diameter.

_______________ 114. The concrete steps along the garage wall extending from the driveway to the front entry are ___ wide.

_______________ 115. There are ___ overhead luminaires shown on the foundation plan.

_______________ 116. The driveway is ___′ wide.

_______________ 117. There are ___ cleanouts for the foundation drain tile.

_______________ 118. The water supply pipes for the water closets are ___″ in diameter.

_______________ 119. There are ___ intercom stations in the house.

_______________ 120. With 1½″ thick plates, the length of the 2 × 10 wall studs for the highest wall shown on section "A" through the entry and living room is ___.

_______________ 121. The drywall for the ceilings is ___″ thick.

_______________ 122. The abbreviation "KD" on section "A" through the garage and studio stands for ___.

_______________ 123. The roof pitch is a(n) ___″ rise for each 12″ of run.

_______________ 124. There are ___ beam pockets formed in the foundation walls.

_______________ 125. The architect is a member of the AIA. This abbreviation stands for ___.

_______________ 126. The elevation at the top of the concrete slab in the screen area is ___.

_______________ 127. The kitchen countertop is ___ high.

_______________ 128. The concrete slab in the crawl space is ___″ thick.

_______________ 129. The roof overhang on the rear portion of the house is ___.

______ 130. There are ___ television connections in the house.

______ 131. There are ___ branch circuit breakers in the house.

______ 132. The abbreviation "GFCI" for the bathroom receptacle outlets indicates ___.

______ 133. The offset in the footing for the wood wall between the garage and the crawl space is ___.

For questions 134 to 143, identify the meaning of the abbreviations.

______ 134. CFM

______ 135. OC

______ 136. CI

______ 137. EL

______ 138. KW

______ 139. DBL

______ 140. WWR

______ 141. CO

______ 142. CONC

______ 143. FDN

______ 144. There are ___ downspouts shown on the east elevation.

______ 145. The circle north of the breakfast room closet is a flue for the ___.

______ 146. The frame to the right of the mirror on the elevation for bath #1 is a(n) ___.

______ 147. The difference in height from the basement floor slab to the foyer is ___.

______ 148. The only adjustable height shelves in the house are in the ___.

______ 149. The backsplash on the kitchen countertop is ___″ high.

______ 150. The hidden lines over the south kitchen cabinets indicate wall ___.

______ 151. The exterior slabs slope ___″.

______ 152. The slope of the garage slab is ___″.

______ 153. The abbreviation "FL" for door #27 indicates that this is a ___ door.

______ 154. There are ___ windows in the studio.

______ 155. The interior window sills in the 2 × 10 stud walls are finished with ___.

_______________ **156.** The distance from the kitchen floor to the top of the kitchen window is ___.

_______________ **157.** Rafter collar ties are spaced ___″ center-to-center.

_______________ **158.** There will be ___ trees remaining on the building lot when construction is completed.

_______________ **159.** The ledge in the foundation wall for the foyer floor joists is ___ deep, ___ wide, and ___ long.

_______________ **160.** From left to right, the three kitchen walls shown on the kitchen interior elevation would be titled with the compass directions of ___, ___, and ___.

_______________ **161.** The abbreviation "LAV" in the bathrooms indicates ___.

_______________ **162.** Create a window schedule for the house using the following format.

Number (Amount)	*Manufacturer's Code or Dimensions*	*Type*

Estimating

_______________ **163.** A total of ___ anchor bolts spaced 2′-0″ OC are required for the foundation walls.

_______________ **164.** Allowing 5% for waste and excluding the frost wall, column footings, and interior basement wall footings, a total of ___ cu yd of concrete is required for the footings for the perimeter foundation walls. (Round the answer to the next highest ¼ cu yd.)

_______________ **165.** What is the cost of the concrete required for the three 4″ thick exterior slabs shown on the foundation plan if concrete costs $45.50 per cu yd? (Round the amount of concrete to the next highest ¼ cu yd.)

_______________ **166.** Damp sand weighs approximately 100 lb/cu ft. What is the cost for the basement sand fill if sand costs $25.75 per ton? (Round the amount of sand to the next highest full ton.)

_______________ **167.** For the two screen porch piers, ___ cu yd of concrete is required. (Round the amount of concrete to the next highest ¼ cu yd.)

_______________ **168.** A total of ___ lf (linear feet) of 2 × 12s is required for the interior stairway treads.

_______________ **169.** Ceramic tile costs $1.15 per sq ft. What is the total cost for the floors in the three bathrooms with the bathtubs at 3′-0″ wide. (Round the area of tile to the next highest full square foot.)

_______________ **170.** A total of ___ sq ft of tile is required for the studio floor. (Round the answer to the next highest full square foot.)

_______________ **171.** If the exterior concrete slab at the rear of the house to the east of the screened area is 8″ thick, ___ cu yd of concrete are required. (Round the answer to the next highest ¼ cu yd.)

_______________ **172.** If concrete costs $45.35 per cu yd, the cost of the concrete footing for the fireplace is $___. (Round the amount of concrete to the next highest ¼ cu yd.)

_______________ **173.** A total of ___ balusters are required in the balcony handrail between the fireplace flue and the outside west wall.

_______________ **174.** A total of ___ sq ft of storage is available on the shelves in the utility closet of door #5.

_______________ **175.** A total of ___ lf of handrail is required between the foyer and the living room.

Appendix

Abbreviations ____ 326

Symbols

- Architectural ____ 330
- Plot Plan ____ 331
- Architectural Graphic ____ 332
- Electrical ____ 333
- Plumbing, Piping, and Valve ____ 335
- HVAC ____ 335

Building Trades Printreading Locator Chart ____ 336

Alphabet of Lines ____ 340

Industry and Standards Organizations ____ 341

ABBREVIATION	TERM	ABBREVIATION	TERM
A		CANTIL	Cantilever
A	Area	CAN.	Canopy
A or AMP	Ampere	CB	Catch Basin
AB	Anchor Bolt	CB	Circuit Breaker
ABBR	Abbreviation	CCF	Concrete Floor
ABV	Above	CEL	Cellar
A C	Air Conditioning	CEM	Cement
ACS	Access	CEM MORT	Cement Mortar
ACSP or AP	Access Panel	CER	Ceramic
ACST	Acoustic	CFM	Cubic Feet Per Minute
ACT or AT.	Acoustical Tile	CHAN	Channel
AD.	Area Drain	CHM	Chimney
ADD.	Addition	CI	Cast Iron
ADH or ADD.	Adhesive	CJ	Control Joint
ADJT or ADJ	Adjustable	CL	Centerline
AGGR	Aggregate	CLG	Ceiling
AIR COND	Air Conditioner	CLG	Cooling
ALUM	Aluminum	CL GL	Clear Glass
ANT.	Antenna	CL or C	Center
AP	Access Panel	CLKG	Caulking
APPROX	Approximately	CLO	Closet
APVD or APPD	Approved	CM	Center Matched
ARCH.	Architectural	CMPSN	Composition
ARCW	Arc Weld	CMU	Concrete Masonry Unit
ASPH	Asphalt	CNCL	Concealed
ASWG	American Steel Wire Gauge	CND	Conduit
AT.	Air Tight	CNDCT	Conductor
AT.	Asphalt Tile	CNTR or CTR	Counter
AVE	Avenue	CO	Cased Opening
AVG, AV or AVE	Average	CO	Cleanout
AWN	Awning	CO	County
		CO	Cut Out
B		COL	Column
B	Bathroom	COM	Common
BARR	Barrier	COMB.	Combination
BC	Between Centers	COMP	Compacted
BC	Bookcase	CONC	Concrete
BCL	Broom Closet	CONSTR	Construction
BD	Board	CONT	Continuous
BDY or BDRY	Boundary	CONTR or CONT	Contract
BEV	Beveled	COR	Corner
BITUM or BIT.	Bituminous	COR	Cornice
BKSH	Bookshelves	CORR	Corrugated
BL	Building Line	CP	Concrete Pipe
BLDG or BL	Building	CPLR	Center of Pillar
BLK	Block	CPR or COP	Copper
BLKG	Blocking	CRE	Corrosion-Resistant
BLT	Bolt	CS or CST	Cast Stone
BLVD	Boulevard	CSG	Casing
BM	Beam	CSMT	Casement
BM	Benchmark	CTD	Coated
BMVP	Barrier, moisture-vapor proof	C TO C	Center-to-Center
BOT or B	Bottom	CTR	Center
BPL or BRG PL	Bearing Plate	CTR	Contour
BR	Bedroom	CU FT	Cubic Foot
BRDG	Bridge	CUTS	Cut Stone
BRG	Bearing	CU YD	Cubic Yard
BRK	Brick	CW	Cold Water
BRS	Brass		
BRZ	Bronze	**D**	
BSMT	Basement	D	Deep
BT	Bathtub	D	Dryer
BTU	British Thermal Unit	D & M	Dressed and Matched
BUR	Built-up Roofing	DB	Decibel
BWP	Barrier, waterproof	DBL	Double
BYP	Bypass	DBL ACT.	Double Acting
		DD	Dutch Door
C		DET or DTL	Detail
CA	Cable	DF	Douglas Fir
CA	Cold Air	DH	Double-Hung
CAB	Cabinet	DHW	Double-Hung Window

ABBREVIATION	TERM	ABBREVIATION	TERM
DIA	Diameter	FS	Full Size
DIAG	Diagram	FTG	Footing
DIM.	Dimension	FUR.	Furnace
DIR	Direction	FUR.	Furring
DK	Deck	FXTR	Fixture
DMPR	Damper	FX WDW	Fixed Window
DMR	Dimmer		
DN	Down	**G**	
DNG R or DR	Dining Room	G	Gas
DP	Dampproofing	GA	Gauge
DP	Depth	GALV	Galvanized
DR	Door	GALVI	Galvanized Iron
DR	Drain	GALVS	Galvanized Steel
DRM	Dormer	GAR.	Garage
DS	Downspout	GFCI	Ground-Fault Circuit Interrupter
DSG	Double-Strength Glass		
DT	Drain Tile	GL	Grade Line
DW	Dishwasher	GL or GLS	Glass
DW	Drywall	GLB	Glass Block
DWG	Drawing	GLULAM	Glued Laminated
DWL	Dowel	GLZ	Glaze
		GND or GRD	Ground
E		GR	Grade
E	East	GRAN	Granulated
EA	Each	GSB	Gypsum Sheathing Board
EL	Elevation	GVL	Gravel
ELEC	Electric or Electrical	GYP	Gypsum
ELEV	Elevation	GYP BD	Gypsum Board
EMT	Electric Metallic Tubing		
ENAM	Enamel	**H**	
ENTR	Entrance	HA	Hot Air
EP	Electric Panelboard	HB	Hose Bibb
EQL	Equal	HBD	Hardboard
EQL SP	Equally Spaced	HC	Hollow Core
EQPT	Equipment	HD	Head
E TO E	End-to-End	HDG	Heading
EXC	Excavate	HDR	Header
EXC	Except	HDW	Hardware
EXHV	Exhaust Vent	HDWD	Hardwood
EXP JT	Expansion Joint	HGR	Hanger
EXPSR	Exposure	HGT	Height
EXST	Existing	HMD	Hollow Metal Door
EXT	Exterior	HNDRL	Handrail
EXT GR	Exterior Grade	HNG	Hinge
EXT	Extinguisher	HOR	Horizontal
		HPT	High Point
F		HTD	Heated
FAB	Fabricate	HTR	Heater
FB	Face brick	HVAC	Heating, Ventilating, and Air Conditioning
FBCK	Firebrick		
FC	Furred Ceiling	HW	Hot Water
FD	Floor Drain	HWY	Highway
FDN	Foundation		
FIG.	Figure	**I**	
FIN. GR	Finish Grade	I	Iron
FL	Flashing	ID	Inside Diameter
FL	Flat	IN.	Inch
FL	Floor	INSTL	Install
FL	Floor Line	INSUL	Insulation
FL	Flush	INTR or INT	Interior
FLD	Field		
FLG or FLR	Flooring	**J**	
FLMT	Flush Mount	J or JST	Joist
FLUOR or FLUR	Fluorescent	JB	Junction Box
FNSH	Finish	JB or JMB	Jamb
FNSH FL	Finished Floor	JT	Joint
FP	Fireplace		
FPRF	Fireproof	**K**	
FR	Frame	K or KIT	Kitchen
FR	Front	KD	Kiln-Dried
FRWK	Framework	KD	Knocked Down

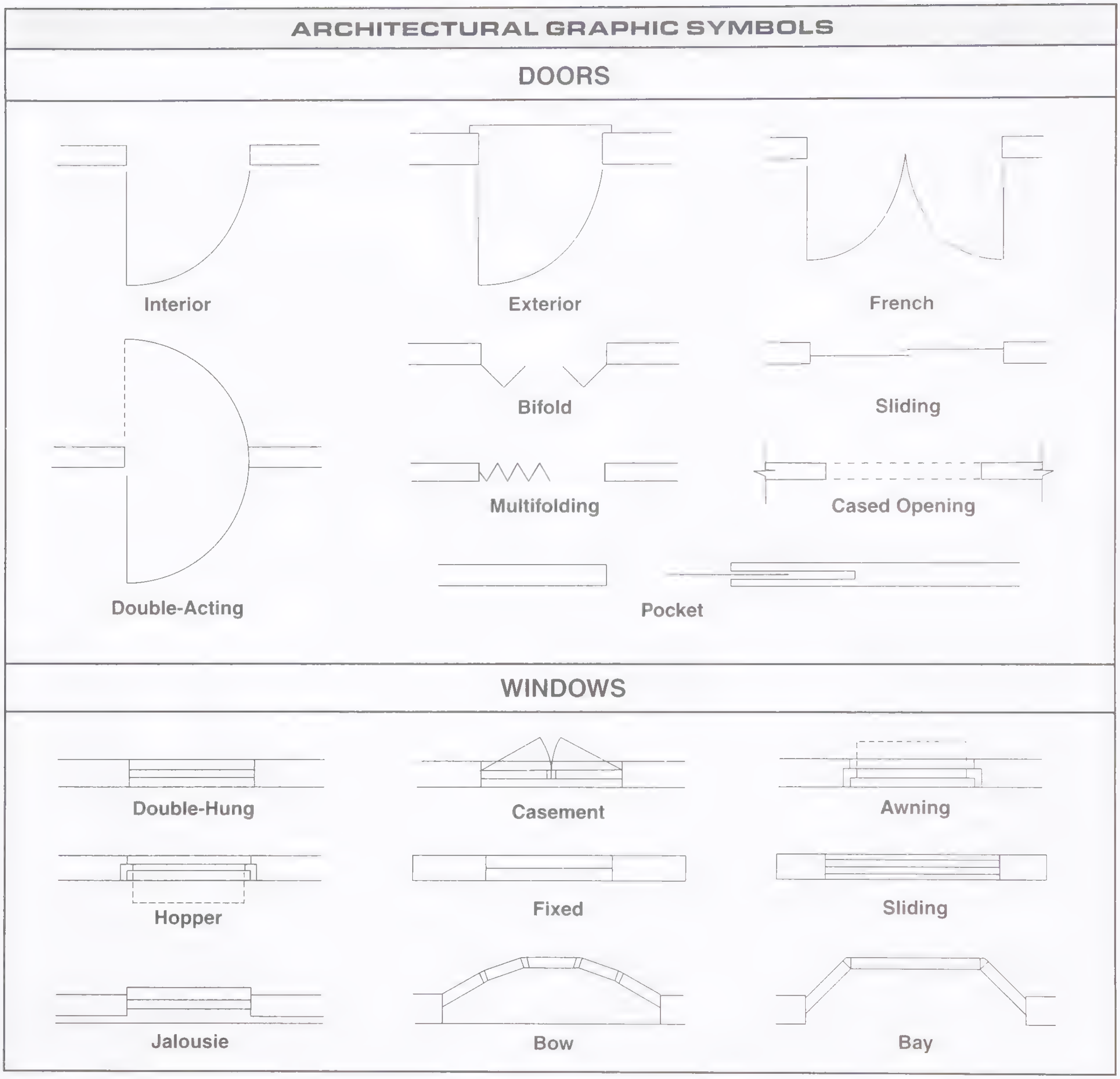
ABBREVIATION	TERM
KPL	Kickplate
KWY	Keyway
L	
LAM	Laminate
LAU	Laundry
LAV	Lavatory
LB	Pound
LBR	Lumber
LBRY or LIB	Library
LCL	Local
LCL or LCLO	Linen Closet
LDG	Landing
LG, L, or LGTH	Length
LINOL or LINO	Linoleum
LKT	Lookout
LNG	Lining
LNTL	Lintel
LP	Low Point
LR	Living Room
LS or LMS	Limestone
LT	Laundry Tray
LT	Light
LTH	Lath
LVL	Level
LVR or LV	Louver
M	
MATL or MTL	Material
MAX.	Maximum
MC	Medicine Cabinet
MDN	Median
MER	Meridian
MET or MTL	Metal
METD	Metal Door
METF	Metal Flashing
METJ	Metal Jalousie
MFR or MFD	Manufacturer
MGS	Metal Gravel Stop
MIN	Minimum
MIR	Mirror
MISC	Miscellaneous
MLDG or MLD	Molding
MN	Main
MO	Masonry Opening
MOR	Mortar
MR or MRB	Marble
MSNRY or MSNY	Masonry
MSTRE	Moisture
MTD	Mounted
MXT or MIX.	Mixture
N	
N	North
NAT	Natural
NEC	National Electrical Code®
NIC	Not in Contract
NO.	Number
NOM	Nominal
NOS	Nosing
NTS	Not to Scale
O	
OA	Overall
OB	Obscure
OC	On-Center
OD	Outside Diameter
OGL or OBSC GL	Obscure Glass
OJ or OW J	Open Web Steel Joist
OP	Operator
OPNG or OPG	Opening
OPP	Opposite
ORD	Ordinance
OUT.	Outlet
OVHD or OH	Overhead
OVHG	Overhang
P	
P	Pitch
P	Porch
PAN	Pantry
PASS	Passage
PC	Piece
PERIM	Perimeter
PFN	Prefinished
PK	Peak
PL	Plate
PL	Property Line
PLAS	Plaster
PLATF or PLAT	Platform
PLGL	Plate Glass
PLMB or PLBG	Plumbing
PLR	Pillar
PLSTC	Plastic
PLYWD	Plywood
PNL	Panel
PNT	Paint
POB	Point of Beginning
PORC	Porcelain
PP	Piping
PR	Pair
PREFAB or PFB	Prefabricated
PRL	Parallel
PRMR	Primer
PROT	Protective
PS	Pull Switch
PSF	Pounds Per Square Foot
PSI	Pounds Per Square Inch
PT	Point
PTD	Painted
PTN	Partition
PVC	Polyvinyl Chloride
PW	Projected Window
PWR	Power
Q	
QT	Quarry Tile
QTR	Quarry-Tile Roof
QTR	Quarter
QTY	Quantity
R	
R	Riser
RAD or R	Radius
RBT or R TILE	Rubber Tile
RC	Reinforced Concrete
RCPT	Receptacle
RD	Road
RD	Roof Drain
RD	Round
RDG	Ridge
RDTR or RAD	Radiator
REBAR	Reinforcing Steel Bar
REC	Recessed
REFR or REF	Refrigerator
REINF or RE	Reinforce
REQD	Required
REV	Revision
RF	Roof
RFG	Roofing
RGH	Rough
RGTR or REG	Register

ABBREVIATION	TERM	ABBREVIATION	TERM
RM or R	Room	TD	Tile Drain
RNDM or RDM	Random	TEL	Telephone
RNG or R	Range	TEM, TEMP, or TMPD	Tempered
RO	Rough Opening	TH	Threshold
RR	Roll Roofing	THERMO	Thermostat
RS	Rough Sawn	THK	Thick
RS	Rubble Stone	THRM	Thermal
RSTPF	Rustproof	TRD, TR, or T	Tread
RTN	Return	TSR	Tile-Shingled Roof
RTNG or RETG	Retaining	TV	Television
RWD	Redwood	TYP	Typical
S		**U**	
S	Scuttle	UGND	Underground
S	South	UNEXC	Unexcavated
SAN	Sanitary	UNFIN or UNF	Unfinished
SB	Splash Block	UR or U RM	Utility Room
SBW	Steel Basement Window		
SC	Scale	**V**	
SC	Sillcock	V	Valve
SC	Solid Core	V	Vent
SCHED or SCH	Schedule	V	Volt
SCRN or SCR	Screen	VAL	Valley
SDG	Siding	VCT	Vitrified Clay Tile
SDL	Saddle	VENT.	Ventilation
SECT. or SEC	Section	VERT or V	Vertical
SEL	Select	VP	Vent Pipe
SEW.	Sewer	VS	Vapor Seal
SF	Soffit	VS	Vent Stack
SH	Shower	VT	Vaportight
SH & RD	Shelf and Rod	VTILE or VT	Vinyl Tile
SH or SHT	Sheet		
SHELV	Shelving	**W**	
SHGL	Shingle	W	Watt
SHK	Shake	W	West
SHTHG	Sheathing	WA, WSCT, or WAIN	Wainscot
SHTR	Shutter	WA	Warm Air
SI LT or SDLT	Sidelight	WC	Water Closet
SK or S	Sink	WD	Wood Door
SLD, SD, or SLDR	Sliding Door	WD	Wood
SLT	Skylight	WDO or WIND.	Window
SLT, S, or SL	Slate	WF	Wide Flange
SM	Sheet Metal	WG	Wire Gauge
SP	Soil Pipe	WH	Water Heater
SP	Standpipe	WH	Weephole
SPEC	Specification	WI	Wrought Iron
SPLY	Supply	WIC	Walk-in Closet
SQ	Square	WJ	Wood Jalousie
SQ FT	Square Foot	WLD	Welded
SS	Steel Sash	WL	Waterline
SSG	Single-Strength Glass	WM	Washing Machine
ST	Stairs	WM	Wire Mesh
ST or STR	Street	W/O	Without
STD	Standard	WP	White Pine
STK	Stack	WP	Weatherproof
STL or ST	Steel	WR	Water-Resistant
STN	Stained	WSHR	Washer
STN	Stone	WSR	Wood-Shingle Roof
STOR	Storage	WS	Weatherstripping
STWY	Stairway	WT	Wood Threshold
SURF.	Surface	WTHPRF or WP	Weatherproof
SUSP	Suspend	WTR or W	Water
SV	Solid Vinyl	WTRPRF or WP	Waterproof
SVCE or SERV	Service	WU	Window Unit
SW or S	Switch	WV	Wall Vent
		WWR	Welded Wire Reinforcement
T			
T	Top	**X-Y-Z**	
T & G	Tongue and Groove	XSECT	Cross Section
TBG	Tubing	YD	Yard
TC	Terra Cotta	YP	Yellow Pine

ARCHITECTURAL SYMBOLS . . .			
MATERIAL	ELEVATION	PLAN	SECTION
Earth			
Brick	WITH NOTE INDICATING TYPE OF BRICK (COMMON, FACE, ETC.)	COMMON OR FACE FIREBRICK	SAME AS PLAN VIEWS
Concrete		LIGHTWEIGHT STRUCTURAL	SAME AS PLAN VIEWS
Concrete Masonry Unit		OR	OR
Stone	CUT STONE RUBBLE	CUT STONE RUBBLE CAST STONE (CONCRETE)	CUT STONE CAST STONE (CONCRETE) RUBBLE OR CUT STONE
Wood	SIDING PANEL	WOOD STUD REMODELING	ROUGH MEMBER TRIM MEMBER PLYWOOD
Plaster		METAL LATH AND PLASTER SOLID PLASTER	LATH AND PLASTER
Roofing	SHINGLES	SAME AS ELEVATION	
Glass	OR GLASS BLOCK	GLASS GLASS BLOCK	SMALL SCALE LARGE SCALE

... ARCHITECTURAL SYMBOLS			
MATERIAL	**ELEVATION**	**PLAN**	**SECTION**
Facing Tile	CERAMIC TILE	FLOOR TILE	CERAMIC TILE LARGE SCALE CERAMIC TILE SMALL SCALE
Structural Clay Tile			SAME AS PLAN VIEW
Insulation		LOOSE FILL OR BATTS RIGID SPRAY FOAM	SAME AS PLAN VIEWS
Sheet Metal Flashing		OCCASIONALLY INDICATED BY NOTE	
Metals Other Than Flashing	INDICATED BY NOTE OR DRAWN TO SCALE	SAME AS ELEVATION	SMALL SCALE STEEL CAST IRON ALUMINUM BRONZE OR BRASS
Structural Steel	INDICATED BY NOTE OR DRAWN TO SCALE	OR	REBAR SMALL SCALE LARGE SCALE L-ANGLES, S-BEAMS, ETC.

PLOT PLAN SYMBOLS			
NORTH	FIRE HYDRANT	WALK	E OR ELECTRIC SERVICE
POINT OF BEGINNING (POB)	MAILBOX	IMPROVED ROAD	G OR NATURAL GAS LINE
UTILITY METER OR VALVE	MANHOLE	UNIMPROVED ROAD	W OR WATER LINE
POWER POLE AND GUY	TREE	BUILDING LINE	T OR TELEPHONE LINE
LIGHT STANDARD	BUSH	PROPERTY LINE	NATURAL GRADE
TRAFFIC SIGNAL	HEDGE ROW	PROPERTY LINE	FINISH GRADE
STREET SIGN	FENCE	TOWNSHIP LINE	+ XX.00′ EXISTING ELEVATION


ARCHITECTURAL GRAPHIC SYMBOLS
DOORS
Interior
Exterior
French
Double-Acting
Bifold
Sliding
Multifolding
Cased Opening
Pocket
WINDOWS
Double-Hung
Casement
Awning
Hopper
Fixed
Sliding
Jalousie
Bow
Bay

ELECTRICAL SYMBOLS . . .

LIGHTING OUTLETS

- OUTLET BOX AND INCANDESCENT LUMINAIRE — CEILING / WALL
- INCANDESCENT TRACK LUMINAIRE
- BLANKED OUTLET — B / B
- DROP CORD — D
- JUNCTION BOX — J / J
- LAMPHOLDER WITH PULL SWITCH — L PS / L PS
- MULTIPLE FLOODLIGHT ASSEMBLY
- INDIVIDUAL FLUORESCENT LUMINAIRE
- OUTLET BOX AND FLUORESCENT LIGHTING TRACK LUMINAIRE
- CONTINUOUS FLUORESCENT LUMINAIRE
- SURFACE-MOUNTED FLUORESCENT LUMINAIRE

PANELBOARDS

- FLUSH-MOUNTED PANELBOARD AND CABINET
- SURFACE-MOUNTED PANELBOARD AND CABINET

CONVENIENCE OUTLETS

- SINGLE RECEPTACLE OUTLET
- DUPLEX RECEPTACLE OUTLET– 120 V
- TRIPLEX RECEPTACLE OUTLET– 240 V
- SPLIT-WIRED DUPLEX RECEPTACLE OUTLET
- SPLIT-WIRED TRIPLEX RECEPTACLE OUTLET
- SINGLE SPECIAL-PURPOSE RECEPTACLE OUTLET
- DUPLEX SPECIAL-PURPOSE RECEPTACLE OUTLET
- RANGE OUTLET — R
- SPECIAL-PURPOSE CONNECTION — DW
- CLOSED-CIRCUIT TELEVISION CAMERA
- CLOCK HANGER RECEPTACLE — C
- FAN HANGER RECEPTACLE — F
- FLOOR SINGLE RECEPTACLE OUTLET
- FLOOR DUPLEX RECEPTACLE OUTLET
- FLOOR SPECIAL-PURPOSE OUTLET

SWITCH OUTLETS

- SINGLE-POLE SWITCH
- DOUBLE-POLE SWITCH — 2
- THREE-WAY SWITCH — 3
- FOUR-WAY SWITCH — 4
- AUTOMATIC DOOR SWITCH — D
- KEY-OPERATED SWITCH — K
- CIRCUIT BREAKER — CB
- WEATHERPROOF CIRCUIT BREAKER — WCB
- DIMMER — DM
- REMOTE CONTROL SWITCH — RC
- WEATHERPROOF SWITCH — WP
- CEILING PULL SWITCH
- SWITCH AND SINGLE RECEPTACLE
- SWITCH AND DOUBLE RECEPTACLE
- A STANDARD SYMBOL WITH AN ADDED LOWERCASE SUBSCRIPT LETTER IS USED TO DESIGNATE A VARIATION IN STANDARD EQUIPMENT

. . . ELECTRICAL SYMBOLS

SIGNALING SYSTEM OUTLETS FOR RESIDENTIAL SYSTEMS

PUSHBUTTON	
BUZZER	
BELL	
BELL AND BUZZER COMBINATION	
COMPUTER DATA OUTLET	
BELL RINGING TRANSFORMER	BT
ELECTRIC DOOR OPENER	D
CHIME	CH
TELEVISION OUTLET	TV
THERMOSTAT	T

ABOVEGROUND ELECTRICAL DISTRIBUTION OR LIGHTING SYSTEMS

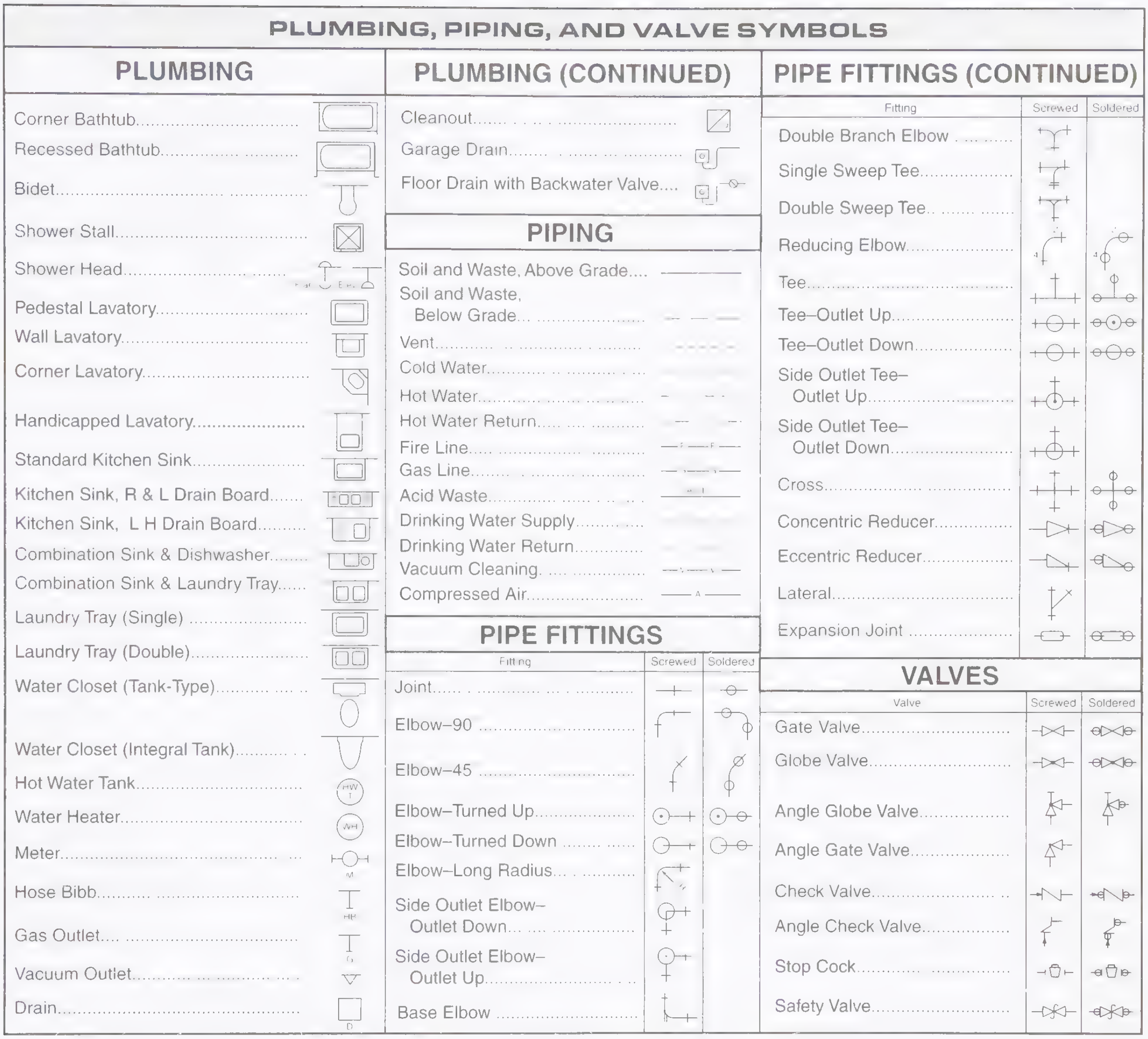
POLE	
STREET LIGHT AND BRACKET	
PRIMARY CIRCUIT	
SECONDARY CIRCUIT	
DOWN GUY	
HEAD GUY	
SIDEWALK GUY	
SERVICE WEATHERHEAD	

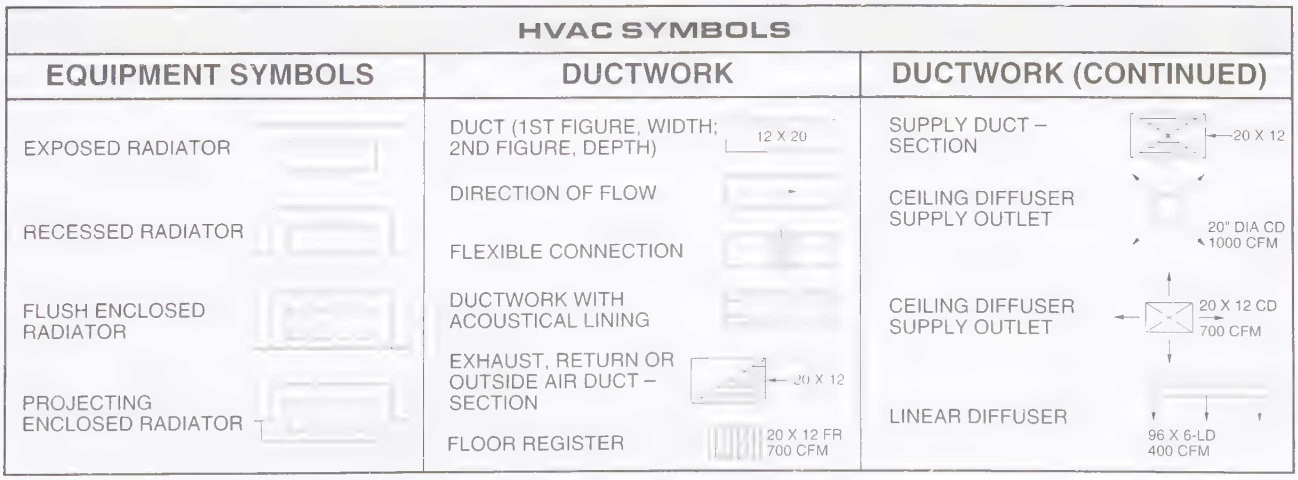
PANEL CIRCUITS AND MISCELLANEOUS

LIGHTING PANEL	
POWER PANEL	
WIRING – CONCEALED IN CEILING OR WALL	
WIRING – CONCEALED IN FLOOR	

PANEL CIRCUITS AND MISCELLANEOUS (CONTINUED)

WIRING EXPOSED	
HOME RUN TO PANELBOARD Indicate number of circuits by number of arrows. Any circuit without such designation indicates a two-wire circuit. For a greater number of wires indicate as follows: -///- (3 wires) -////- (4 wires), etc.	
FEEDERS Use heavy lines and designate by number corresponding to listing in feeder schedule	
WIRING TURNED UP	
WIRING TURNED DOWN	
GENERATOR	G
MOTOR	M
INSTRUMENT (SPECIFY)	I
TRANSFORMER	T


PLUMBING, PIPING, AND VALVE SYMBOLS
PLUMBING
Corner Bathtub
Recessed Bathtub
Bidet
Shower Stall
Shower Head
Pedestal Lavatory
Wall Lavatory
Corner Lavatory
Handicapped Lavatory
Standard Kitchen Sink
Kitchen Sink, R & L Drain Board
Kitchen Sink, L H Drain Board
Combination Sink & Dishwasher
Combination Sink & Laundry Tray
Laundry Tray (Single)
Laundry Tray (Double)
Water Closet (Tank-Type)
Water Closet (Integral Tank)
Hot Water Tank
Water Heater
Meter
Hose Bibb
Gas Outlet
Vacuum Outlet
Drain
HW T
WH
M
HB
G
D
PLUMBING (CONTINUED)
Cleanout
Garage Drain
Floor Drain with Backwater Valve
PIPING
Soil and Waste, Above Grade
Soil and Waste, Below Grade
Vent
Cold Water
Hot Water
Hot Water Return
Fire Line
Gas Line
Acid Waste
Drinking Water Supply
Drinking Water Return
Vacuum Cleaning
Compressed Air
F
G
A
PIPE FITTINGS
Fitting
Screwed
Soldered
Joint
Elbow–90
Elbow–45
Elbow–Turned Up
Elbow–Turned Down
Elbow–Long Radius
Side Outlet Elbow–Outlet Down
Side Outlet Elbow–Outlet Up
Base Elbow
PIPE FITTINGS (CONTINUED)
Fitting
Screwed
Soldered
Double Branch Elbow
Single Sweep Tee
Double Sweep Tee
Reducing Elbow
Tee
Tee–Outlet Up
Tee–Outlet Down
Side Outlet Tee–Outlet Up
Side Outlet Tee–Outlet Down
Cross
Concentric Reducer
Eccentric Reducer
Lateral
Expansion Joint
VALVES
Valve
Screwed
Soldered
Gate Valve
Globe Valve
Angle Globe Valve
Angle Gate Valve
Check Valve
Angle Check Valve
Stop Cock
Safety Valve


HVAC SYMBOLS
EQUIPMENT SYMBOLS
EXPOSED RADIATOR
RECESSED RADIATOR
FLUSH ENCLOSED RADIATOR
PROJECTING ENCLOSED RADIATOR
DUCTWORK
DUCT (1ST FIGURE, WIDTH; 2ND FIGURE, DEPTH)
12 X 20
DIRECTION OF FLOW
FLEXIBLE CONNECTION
DUCTWORK WITH ACOUSTICAL LINING
EXHAUST, RETURN OR OUTSIDE AIR DUCT – SECTION
20 X 12
FLOOR REGISTER
20 X 12 FR
700 CFM
DUCTWORK (CONTINUED)
SUPPLY DUCT – SECTION
20 X 12
CEILING DIFFUSER SUPPLY OUTLET
20" DIA CD
1000 CFM
CEILING DIFFUSER SUPPLY OUTLET
20 X 12 CD
700 CFM
LINEAR DIFFUSER
96 X 6-LD
400 CFM

BUILDING TRADES PRINTREADING LOCATOR CHART . . .		
TRADE	**PLOT PLAN**	**FOUNDATION PLAN**
Bricklayer/ Stone Mason	• Brick and stone paving for driveways and walkways • Ornamental and structural columns (locations and materials) • Brick steps (elevations and dimensions) • Brick or stone retaining walls (elevations, materials, and dimensions)	• Materials for foundation walls (concrete masonry units/brick/brick veneer) • Dimensions of masonry foundation walls • Opening locations and sizes in masonry foundation walls • Fireplace footing and foundation locations and dimensions
Carpenter	• Building lines • Elevations for floors and foundations • Overall dimensions of house	• Foundation type and dimensions • Footing type and dimensions • Basement door and window locations, sizes, and types • Basement column locations, sizes, and types • Beam locations, sizes, and types • Finished areas of basement (wall dimensions and finish materials) • Basement stairway locations • First floor framing information (joist sizes and spacings)
Cement Mason/ Finisher	• Dimensions, locations, materials, and elevations for driveways and walkways	• Basement floor materials, reinforcement, and thickness
Electrician	• Location of transformer/power pole	• Basement receptacle outlets, luminaires, and switches (types and locations) • Circuit loads • Location of main service panelboard • Appliance types (water heater/furnace/washer/dryer) and electrical requirements for each
Excavator/ Operating Engineer	• Existing and finish grade of building lot • Trees to remain or remove • Elevation and dimensions of floor and basement • Locations of utility trenches and easement • Locations and dimensions of walkways, driveways, and patios	• Footing and foundation types, dimensions, and elevations • Pier hole locations, diameters, and depths
Floorlayer		• Basement flooring installed in finished areas

. . . BUILDING TRADES PRINTREADING LOCATOR CHART . . .			
EXTERIOR ELEVATIONS	**FLOOR PLANS**	**DETAILS**	**SPECIFICATIONS**
• Exterior wall finish materials (concrete masonry units/brick/stone) • Decorative exterior masonry work (designs/ dimensions/materials) • Lintel materials and sizes • Sills • Fireplace exterior materials and dimensions • Flue material and design	• Wall building materials (concrete masonry units/ brick/stone) • Masonry wall dimensions and opening locations/sizes • Ornamental and structural column location/sizes/materials • Porch and driveway paving materials • Fireplace sizes/locations/ materials	• Fireplace dimensions and materials • Typical wall section masonry materials • Ornamental masonry work • Retaining wall construction methods/materials	• Brick/stone type, pattern, and color • Mortar requirements
• Exterior finish siding and trim materials • Window sizes and types • Exterior door types and sizes • Roof pitches • Roof covering materials • Floor heights and elevations • Footing and foundation types, sizes, and locations	• Overall floor dimensions • Wall locations, sizes, and construction materials • Door and window locations, sizes, and types • Interior finish materials and trim moldings • Ceiling and roof framing materials and spacings • Attic scuttle location and size • Cabinetry locations and types • Stairway information (locations/ number of risers/dimensions) • Closet shelf information	• Cabinetry layout and types • Typical wall section framing and finish materials for floors, walls, ceilings, and roofs • Insulation types and locations • Footing and foundation types, sizes, reinforcement, and materials	• Lumber types • Framing construction requirements • Window and door information • Footing and foundation material information • Interior and exterior finish material information
• Exterior concrete paving locations and elevations • Exterior stairway locations and dimensions • Architectural finished concrete walls	• Exterior stairway locations and dimensions • Concrete patio locations, dimensions, reinforcement, and thickness	• Exterior concrete stairways and porches (dimensions and slopes)	• Concrete thickness, strength, and reinforcement requirements
• Exterior luminaires	• Interior and exterior receptacle outlets, luminaires, and switches (types and locations) • Circuit loads • Location of main service panel • Appliance types (water heater/ furnace/washer/dryer/exhaust fan/cooktop and range/ refrigerator) and electrical requirements for each	• Luminaire locations and types • Appliance locations and types • Electrical drawing showing circuit layout	• Appliance information • Electrical luminaire allowance • Type of service panelboard and wiring materials
• Finish grade at house • Footing and foundation types and elevations • Pier hole locations and depths	• First floor elevation	• Finish grade at retaining walls, porches, and patios	• Topsoil requirements
	• Interior finish flooring materials	• Typical wall section underlayments and finish flooring materials	• Manufacturers' styles and colors • Finish floor, padding for carpet, and underlayment information

. . . BUILDING TRADES PRINTREADING LOCATOR CHART . . .		
TRADE	**PLOT PLAN**	**FOUNDATION PLAN**
HVAC/Sheet Metal	• Air conditioner location	• Furnace and air conditioner location and type • Heating and cooling installations in finished basement areas • Sizes of vents and air returns for forced air systems • Pipe sizes and radiator locations for radiant systems • Exhaust fan types and venting requirements
Laborer	• Demolition of existing structures on building lot • Footing and foundation elevations • Existing and finish grade of building lot • Trees to remain or remove • Locations of utility trenches and easement • Locations and dimensions of walkways, driveways, and patios	• Footing and foundation types, sizes, and elevations • Floor drain locations and plumbing trenches • Basement drain tile locations
Painter		• Wall and ceiling finish in basement living areas
Plumber	• Water supply location and type of service • Wastewater disposal system and type of service • Natural gas supply location and type of service	• Floor drains in basement • Water heater location • Plumbing fixtures (sinks/water closets/water supplies) in basement • Furnace/boiler location and type for natural gas piping
Roofer		
Tile Setter		• Floor, wall, and ceiling finish in basement living areas

... BUILDING TRADES PRINTREADING LOCATOR CHART			
EXTERIOR ELEVATIONS	**FLOOR PLANS**	**DETAILS**	**SPECIFICATIONS**
• Flashing locations and materials • Gutter and downspout materials and locations • Metal roofing materials and locations	• Furnace and air conditioner location and type • Sizes of vents and air returns for forced air systems • Pipe sizes and radiator locations for radiant systems • Exhaust fan types and venting requirements	• Flashing locations and materials	• Manufacturer names and types for exhaust fans/furnace/boiler/air conditioner • Ducting/piping material requirements
• Finish grade at house	• Porch and patio dimensions and materials	• Retaining wall dimensions and materials • Typical wall section footing and foundation materials	
• Exterior siding and trim finishes	• Interior wall and ceiling finishes	• Interior and exterior finishes	• Colors and paint manufacturer
	• Water heater location • Plumbing fixtures (sinks/water closets/bathtubs/showers/dishwashers/supplies) • Furnace/boiler location and type for natural gas piping • Exterior hose bibbs	• Isometric view of supply and waste piping showing fittings and sizes and types of pipe materials • Fixture locations and types	• Manufacturer names and types for water heater and plumbing fixtures • Types of supply and waste piping and fittings
• Roof pitch • Type of roof covering materials		• Typical wall section roofing materials	• Types of roofing materials
• Tile exterior trim	• Floor, wall, and ceiling finish in living areas • Tile paving on porches and patios	• Tile types and locations in kitchen and bath details	• Manufacturer names and types of tile materials

ALPHABET OF LINES

NAME AND USE	CONVENTIONAL REPRESENTATION	EXAMPLE
Object Line Define shape. Outline and detail objects.	THICK	OBJECT LINE
Hidden Line Show hidden features.	$\frac{1}{8}$" (3 mm) THIN $\frac{1}{32}$" (0.75 mm)	HIDDEN LINE
Centerline Locate centerpoints of arcs and circles.	$\frac{1}{16}$" (1.5 mm) THIN $\frac{1}{8}$" (3 mm) $\frac{3}{4}$" (18 mm) TO $1\frac{1}{2}$" (36 mm)	CENTERLINE CENTERPOINT
Dimension Line Show size or location. **Extension Line** Define size or location.	DIMENSION LINE DIMENSION THIN 2'-6" EXTENSION LINE	DIMENSION LINE $1\frac{1}{4}$ EXTENSION LINE
Leader Call out specific features.	OPEN ARROWHEAD THIN X CLOSED ARROWHEAD 3X	$1\frac{1}{2}$ DRILL LEADER
Cutting Plane Show internal features.	THICK $\frac{1}{8}$" (3 mm) $\frac{1}{16}$" (1.5 mm) A A $\frac{3}{4}$" (18 mm) TO $1\frac{1}{2}$" (36 mm)	A A LETTER IDENTIFIES SECTION VIEW CUTTING PLANE LINE
Section Line Identify internal features.	$\frac{1}{16}$" (1.5 mm) THIN	SECTION LINES
Break Line Show long breaks. **Break Line** Show short breaks.	$\frac{3}{4}$" (18 mm) TO $1\frac{1}{2}$" (36 mm) THIN FREEHAND THICK	LONG BREAK LINE SHORT BREAK LINE

INDUSTRY AND STANDARDS ORGANIZATIONS . . .	
ACCA Air Conditioning Contractors of America, Inc. 2800 Shirlington Rd Ste 300 Arlington, VA 22206 www.acca.org	**ASME** ASME International 3 Park Avenue New York, NY 10016 www.asme.org
ARI Air Conditioning and Refrigeration Institute 4301 N Fairfax Dr Ste 425 Arlington, VA 22203 www.ari.org	**ABC** Associated Builders and Contractors, Inc. 1300 N 17th St Ste 800 Rosslyn, VA 22209 www.abc.org
AAMA American Architectural Manufacturers Association 1827 Walden Office Sq Ste 104 Schaumburg, IL 60173 www.aamanet.org	**AGC** Associated General Contractors of America 333 John Carlyle St Ste 200 Alexandria, VA 22314
ACI American Concrete Institute PO Box 9094 Farmington Hills, MI 48333 www.aci-int.org	**AWCI** Association of the Wall and Ceiling Industries International 803 West Broad St Ste 600 Falls Church, VA 22046 www.awci.org
AIA American Institute of Architects 1735 New York Ave NW Washington, DC 20006 www.aia.org	**ASTM** ASTM International 100 Barr Harbor Dr PO Box C700 West Conshohocken, PA 19428
ANSI American National Standards Institute 1819 L St NW Washington, DC 20036 www.ansi.org	**BIA** Brick Industry Association 11490 Commerce Park Dr Reston, VA 20191 www.bia.org
ASCC American Society of Concrete Contractors 1801 Royal Ln Ste 704 Dallas, TX 75229 www.ascconc.org	**CRSI** Concrete Reinforcing Steel Institute 933 N Plum Grove Rd Schaumburg, IL 60173 www.crsi.org
ASHRAE American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. 1791 Tullie Cir NE Atlanta, GA 30329 www.ashrae.org	**CSI** Construction Specifications Institute 99 Canal Center Plaza Ste 300 Alexandria, VA 22314 www.csinet.org
ASPE American Society of Professional Estimators 11141 Georgia Ave Ste 412 Wheaton, MD 20902 www.aspenational.com	**CDA** Copper Development Association 260 Madison Avenue New York, NY 10016 www.copper.org
APA APA—The Engineered Wood Association PO Box 11700 Tacoma, WA 98411 www.apawood.org	**DHI** Door and Hardware Institute 14150 Newbrook Dr Ste 200 Chantilly, VA 20151 www.dhi.org
AWI Architectural Woodwork Institute 1952 Isaac Newton Square West Reston, VA 20190 www.awinet.org	**EPA** Environmental Protection Agency Ariel Rios Bldg 1200 Pennsylvania Ave NW Washington, DC 20460 www.epa.gov

. . . INDUSTRY AND STANDARDS ORGANIZATIONS . . .	
GA Gypsum Association 810 First St NE 510 Washington, DC 20002 www.gypsum.org	**OPCMIA** Operative Plasterers' and Cement Masons' International Association of the United States and Canada 11405 Laurel Pl Ste 300 Laurel, MD 20707 www.opcmia.org
IAPMO International Association of Plumbing and Mechanical Officials 20001 E Walnut Dr S Walnut, CA 91789 www.iapmo.org	**PDCA** Painting and Decorating Contractors of America 3913 Old Lee Hwy 2nd Fl Fairfax, VA 22030 www.pdca.org
IBEW International Brotherhood of Electrical Workers 125 15th St NW Washington, DC 20005 www.ibew.org	**PPFA** Plastic Pipe and Fittings Association 800 Roosevelt Rd Bldg C Ste 20 Glen Ellyn, IL 60137 www.ppfahome.org
ICC International Code Council 5203 Leesburg Pike Ste 600 Falls Church, VA 22041 www.iccsafe.org	**PPI** Plastics Pipe Institute, Inc. 1825 Connecticut Ave NW Ste 680 Washington, DC 20009 www.plasticpipe.org
IMI International Masonry Institute The James Brice House 42 East St Annapolis, MD 21401 www.imiweb.org	**PCA** Portland Cement Association 5420 Old Orchard Rd Skokie, IL 60007 www.portcement.org
BAC International Union of Bricklayers and Allied Craftsmen 815 15th St NW Washington, DC 20005 www.bacweb.org	**RFCI** Resilient Floor Covering Institute 401 E Jefferson St Ste 102 Rockville, MD 20850 www.rfci.com
IUPAT International Union of Painters and Allied Trades 1750 New York Ave NW Washington, DC 20006	**SSMA** Steel Stud Manufacturers Association 8 S Michigan Ave Ste 1000 Chicago, IL 60603 www.ssma.com
MCAA Mechanical Contractors Association of America 1385 Piccard Dr Rockville, MD 20850 www.mcaa.org	**TCA** Tile Council of America 100 Clemson Research Blvd Anderson, SC 29625 www.tileusa.com
NAHB National Association of Home Builders 1201 15th St NW Washington, DC 20005 www.nahb.com	**HUD** U.S. Department of Housing and Urban Development 451 7th St SW Washington, DC 20410 www.hud.gov
NFPA National Fire Protection Association 1 Batterymarch Park Quincy, MA 02269 www.nfpa.org	**OSHA** U.S. Department of Labor/Occupational Safety and Health Administration 200 Constitution Ave NW Washington, DC 20210 www.osha.gov
NRMCA National Ready Mixed Concrete Association 900 Spring St Silver Spring, MD 20910 www.nrmca.org	**UL** Underwriters Laboratories, Inc. 333 Pfingston Rd Northbrook, IL 60062 www.ul.com

... INDUSTRY AND STANDARDS ORGANIZATIONS	
UA United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada 901 Massachusetts Ave NW Washington, DC 20001 www.ua.org	**WWPA** Western Wood Products Association 522 SW 5th Ave Ste 500 Portland, OR 97204-2122 www.wwpa.org
UBC United Brotherhood of Carpenters and Joiners of America 101 Constitution Ave NW Washington, DC 20001 www.carpenters.org	**WDMA** Window and Door Manufacturers Association 1400 E Touhy Ave Ste 470 Des Plaines, IL 60018 www.nwwda.org
UURWAW United Union of Roofers, Waterproofers and Allied Workers 1660 L St NW Ste 800 Washington, DC 20036 www.unionroofers.com	**WRI** Wire Reinforcement Institute 301 E Sandusky St Findlay, OH 45840-0450 www.bright.net/~wwri

Glossary

A

abbreviation: Letter or series of letters of words denoting a complete word.

acronym: Abbreviated word formed from the first letter of each word that describes the article.

acute triangle: Triangle in which all angles are less than 90°.

addition: Process of combining two or more whole numbers to obtain a total.

air conditioner: Piece of equipment used to control humidity and temperature and remove airborne impurities in a house.

air conditioning: Process used to control humidity, temperature, and/or cleanliness of air within a house.

arc: Portion of the circumference of a circle.

architect's scale: Drafting scale used when producing drawings of buildings and structural parts.

area: Two-dimensional surface measurement.

B

balloon framing: System of frame construction in which one-piece exterior wall studs extend from the first floor line or sill plate to the double top plate.

baseline: East-west line that defines a group of townships on a grid.

benchmark: Stake driven into the ground or a point in a street or along a curb that is used as the point of beginning.

blower: Piece of equipment that draws air from rooms and moves it through the furnace where it is heated before being conveyed back into the rooms.

boiler: Closed tank connected to an energy source that heats water to a high temperature.

brick bond: Pattern formed by exposed faces of brick.

brick veneer construction: Frame construction with brick exterior facing.

bridging: Metal or wood cross bridging or solid wood blocking installed between joists to stiffen a floor unit and prevent joists from twisting.

built-up beam: Structural member made of laminated wood members, designed to carry heavy loads.

C

chord: A line from circumference to circumference that does not pass through the centerpoint of a circle.

circle: Plane figure generated around a centerpoint.

circulating pump: Device that moves water through supply water piping in a hot water heating system.

circumference: Outside edge of a circle.

civil engineer's scale: Drafting scale used when creating maps and survey drawings.

compass: Drafting instrument used to draw arcs and circles.

compression tank: Tank that absorbs and relieves pressure caused by water expansion when heated.

computer: Device that receives information from an input device, processes it, and displays the results on a monitor.

contemporary design: Architectural design that reflects current trends and may include more complex rooflines, geometric windows, and curved or angled walls.

contour line: Dashed or solid line on a plot plan that passes through points having the same elevation.

cutting plane line: Line that identifies the exact place where a cutting plane passes through a feature.

D

decimal fraction: Fraction with a denominator of 10, 100, 1000, 10,000, and so on.

denominator: Part of a fraction that indicates the total number of parts or divisions of a whole number.

detail: Scaled plan, elevation, or section drawn to a larger scale to show special features.

diameter: Distance from circumference to circumference passing through the centerpoint of a circle.

dividend: Number divided in the division operation.

dividers: Drafting instrument used for transferring dimensions.

division: Mathematical process of determining the number of times one number is contained in another number.

divisor: Number that a dividend is divided by in the division operation.

door hand: Direction a door swings.

dormer: Projection from a sloping roof that provides additional interior area.

duplex nail: Double-headed nail designed to be pulled out easily to facilitate the stripping of forms.

E

easement: Strip of privately owned land set aside for placement of public utilities.

electric radiant heating system: Radiant heating system in which heat is generated when electricity meets resistance as it flows through embedded heating cables or baseboard units.

elevation: **1.** A scaled view looking directly at the walls. **2.** A vertical measurement above or below the point of beginning.

ellipse: Plane figure generated by the sum of the distances from two fixed points.

equilateral triangle: Acute triangle that contains three equal sides and three 60° angles.

even number: Number that can be divided by two without a remainder or decimal occurring.

exterior elevation: Scaled view that shows the shape and size of the outside walls of the house and the roof.

exterior insulation and finish system (EIFS): System used to provide exterior building protection through application of exterior insulation, insulation board, reinforcing mesh, a base coat of acrylic copolymers and portland cement, and a finish coat of acrylic resins.

F

finish grade: Slope of the land after final grading.

fire cut: Angled cut in the end of a wood joist that allows a burnt joist to fall out without disturbing the solid brick wall.

floor plan: Scaled view of the various floors in a house looking directly down from a horizontal cutting plane taken 5′-0″ above each finished floor.

flush door: Door with flat surfaces with the stiles and rails within the door.

footing: Support base for a foundation wall.

forced warm air heating system: Residential heating system that uses a blower to draw air (return air) from rooms through return air grilles and ductwork.

function key: Key on a keyboard that performs a special task.

furnace: Piece of equipment that heats the air circulating in a forced warm air heating system.

G

general note: Notation that refers to an entire set of prints.

geothermal heat: Heat that is derived from heat contained within the earth.

H

hollow-core door: Flush door with wood surface veneers, a solid wood frame, and a mesh core.

horizontal line: Line that is level or parallel to the horizon.

hot water radiant heating (hydronic) system: Radiant heating system in which water is heated in a boiler at a central location and then distributed to the desired rooms through tubing.

I

improper fraction: Fraction with the numerator larger than the denominator. An improper fraction must be converted to a mixed number.

interior elevation: Scaled view that shows the shapes, sizes, and finishes of interior walls and partitions of a house.

irregular polygon: Polygon that has unequal sides and unequal angles.

isometric drawing: Pictorial drawing with horizontal lines drawn 30° above (or below) the horizon.

isosceles triangle: A triangle that contains two equal sides and two equal angles.

J

job-built form: Foundation wall form constructed piece by piece on top of a footing.

joist: Horizontal framing member that supports a floor.

K

keyboard: Input device containing standard alpha and numeric keys as well as function keys.

keyway: Groove formed in fresh concrete that interlocks with concrete from a foundation wall.

kilogram: Basic unit of weight in the SI metric system.

L

light: Pane of glass.

location dimension: Dimension that locates a particular feature in relation to another feature.

longitudinal section: Section created by passing a cutting plane through the long dimension of a house.

M

masonry construction: System of construction in which masonry units such as brick, concrete masonry units, stone, or structural clay tile are formed into walls to carry the load of floor and roof joists.

mechanical engineer's scale: Drafting scale used when drawing machines and machine parts.

meridian: North-south line that defines a group of townships on a grid.

meter: Basic unit of measurement in the SI metric system.

minuend: Total number of units prior to subtraction.

mixed decimal number: Decimal number consisting of a whole number and a decimal number separated by a decimal point.

mixed number: Fraction containing a whole number and a fraction.

model code: National building code developed through conferences between building officials and industry representatives around the country.

modular brick: Brick classified by its actual size and designed so every third horizontal joint falls on a multiple of 4″ (modular measure).

monitor: High-resolution color display screen that allows drawings, data, and text to be displayed.

multiplicand: Number being multiplied in the multiplication operation.

multiplication: Mathematical process of adding a number to itself as many times as there are units indicated by the other number.

multiplier: Number in the multiplication operation that indicates the number of times the addition should occur.

N

natural grade: Slope of the land before rough grading.

nominal size: Size of a piece of wood before it is planed to finished size.

numerator: Part of a fraction that indicates the number of parts included in the fraction.

O

oblique drawing: Pictorial drawing with one surface drawn in true shape and receding lines projecting back from the face.

obtuse triangle: Triangle that includes one angle greater than 90°.

odd number: Number that cannot be divided by two without a remainder or decimal occurring.

operating controls: Controls that cycle equipment ON and OFF as required.

orthographic projection: Drawing in which each face of an object is projected onto flat planes, generally at 90° to one another.

P

panel door: Door with individual panels between the stiles and rails.

panel form: Prefabricated concrete wall form consisting of a metal frame and metal or wood panel facing, or wood studs and plates with wood panel facing.

panned ceiling: Ceiling consisting of two ceiling levels connected by sloped surfaces.

perspective drawing: Pictorial drawing with all receding lines converging to vanishing points.

pictorial drawing: Three-dimensional representation of an object.

piping: Tubing used to distribute hot water from the boiler to terminal devices and return water back to the boiler to be reheated.

pitch: Angle a roof slopes from the roof ridge to the outside walls of the building.

place: Position that a digit occupies; it represents the value of the digit.

plane figure: Geometric shape with a flat surface.

platform framing: System of frame construction in which each story of a building is framed as a unit, with studs being one story in height.

plot plan: Scaled drawing that shows the shape and size of the building lot; location, shape, and overall size of a house on the lot; and the finish floor elevation.

point of beginning (POB): Location point from which horizontal dimensions and vertical elevations are made.

polygon: Many-sided plane figure that is bounded by straight lines.

post-and-beam framing: System of frame construction in which posts and beams provide the primary structural support.

potable water: Water free from impurities in amounts that could cause disease or harmful effects.

power controls: Controls located in the electrical conductors leading to the furnace and blower.

prime number: Odd number that can only be divided by 1 or itself without a remainder or decimal occurring.

print: Reproduction of a working drawing.

product: Result of multiplication.

proper decimal number: Decimal number that does not have a whole number, such as .9.

Q

quadrant: One-fourth of a circle.

quadrilateral: Four-sided plane figure.

quotient: The result of the division operation.

R

raceway: Enclosed channel designed to protect electrical conductors.

radiant heating system: Heating system that transfers heat to the living space via hot water tubing or electrical cables embedded in the floor or ceiling.

radius: One-half the diameter of a circle.

rebar: Deformed steel bar used to reinforce concrete structural members.

rectangle: Quadrilateral that contains four 90° angles with opposite sides equal.

regular polygon: Polygon that has equal sides and equal angles.

result: Difference between the minuend and subtrahend in the subtraction operation.

rhomboid: Quadrilateral that has opposite sides equal, opposite angles equal, but does not contain any 90° angles.

rhombus: Quadrilateral that contains four equal sides with opposite angles equal and no 90° angles.

right triangle: Triangle that contains one 90° angle.

riser: Vertical portion of a stair step.

S

safety controls: Controls that prevent injury to personnel or damage to equipment in the event of equipment malfunction.

scale: Drafting tool used to measure lines and reduce or enlarge them proportionally.

scuttle: Access opening in a ceiling or roof with a removable or movable cover.

section: **1.** Scaled view created by passing a cutting plane through a portion of a building. **2.** Division of a township and is one mile long on each side.

sector: Pie-shaped segment of a circle.

semicircle: One-half of a circle.

size dimension: Dimension that indicates the size of a particular area or feature.

sketching: Process of drawing without instruments.

slab-on-grade foundation: Ground-supported foundation system that combines short concrete foundation walls or a thickened concrete edge with a concrete floor slab.

slanted line: Inclined line that is neither horizontal nor vertical.

slope: Relationship of unit rise to unit run of a roof.

solar energy: Energy available from the sun in the form of sunlight.

solid-core door: Flush door with wood surface veneer and an inner core made of solid wood blocks, engineered wood products, or high-density foam.

specifications: Written supplements to working drawings that provide additional building information.

square: Quadrilateral that contains four equal sides and four 90° angles.

standard brick: Brick classified by its nominal size.

structural insulated panel: Structural member consisting of a thick layer of rigid foam insulation pressed between two OSB or plywood panels.

subtraction: Mathematical process of taking one number away from another number.

subtrahend: Number of units to be removed from the minuend in the subtraction operation.

sum: Total that results from addition.

survey plat: Map showing a division of land, such as a portion of a quarter section of a township subdivided into streets and lots.

symbol: Pictorial representation of a structural or material component used on prints.

T

terminal device: Device that extracts heat from hot water to heat the air in the desired rooms.

title block: Area on a working drawing or print that is used to provide written information about the drawing or print.

township: Square area that is six miles long on each side, or 36 square miles.

traditional design: Architectural design that reflects long-standing design elements.

transverse section: Section created by passing a cutting plane through the short dimension of a house.

trapezium: Quadrilateral that has no sides parallel.

trapezoid: Quadrilateral that has two sides parallel.

tread: Horizontal portion of a stair step.

triangle: **1.** Drafting tool used to draw vertical and inclined lines. **2.** Three-sided plane figure that contains 180°.

T-square: Drafting tool used to draw horizontal lines and as a reference base for positioning triangles.

typical note: Notation that refers to all similar items on the prints.

U

unit controls: Controls installed on a furnace by the manufacturer or installer to maintain safe and efficient operation of the furnace.

unit rise: Vertical increase in height per foot of run.

unit run: Unit of the total run based on 12″.

V

vertical line: A line that is plumb or upright.

voice/data/video (VDV) system: Low-voltage electrical system designed for use with various types of information technology equipment, including telephone systems, computer systems and networks, television video systems for cable and/or satellite dish systems, and security and fire alarm systems.

volume: Three-dimensional capacity of a space.

W

walkout basement: Basement with standard-sized windows to provide light and standard-sized doors for entry and exit.

whole number: Number that does not have a fractional or decimal part.

working drawing: Drawing that contains the graphic information necessary to complete a construction job.

wythe: Single continuous masonry wall, one unit thick.

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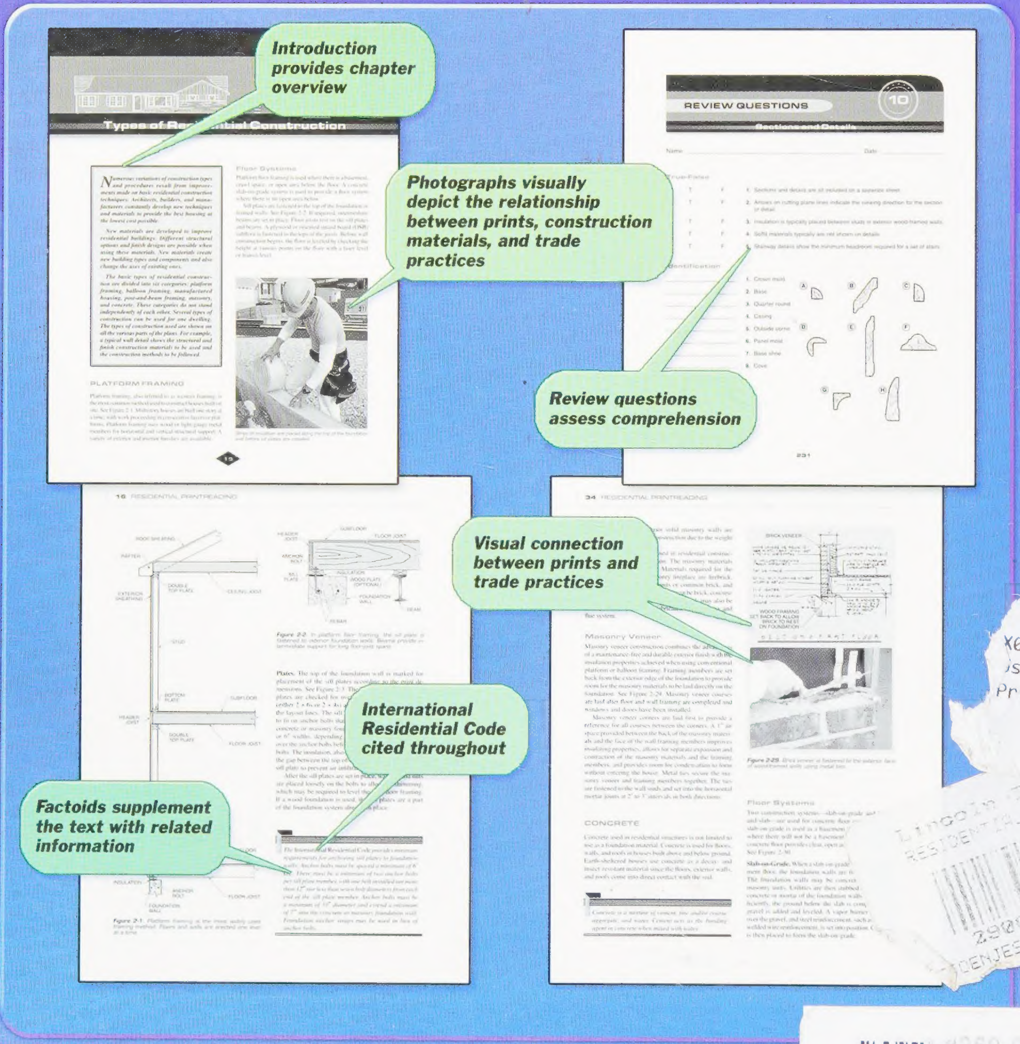

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